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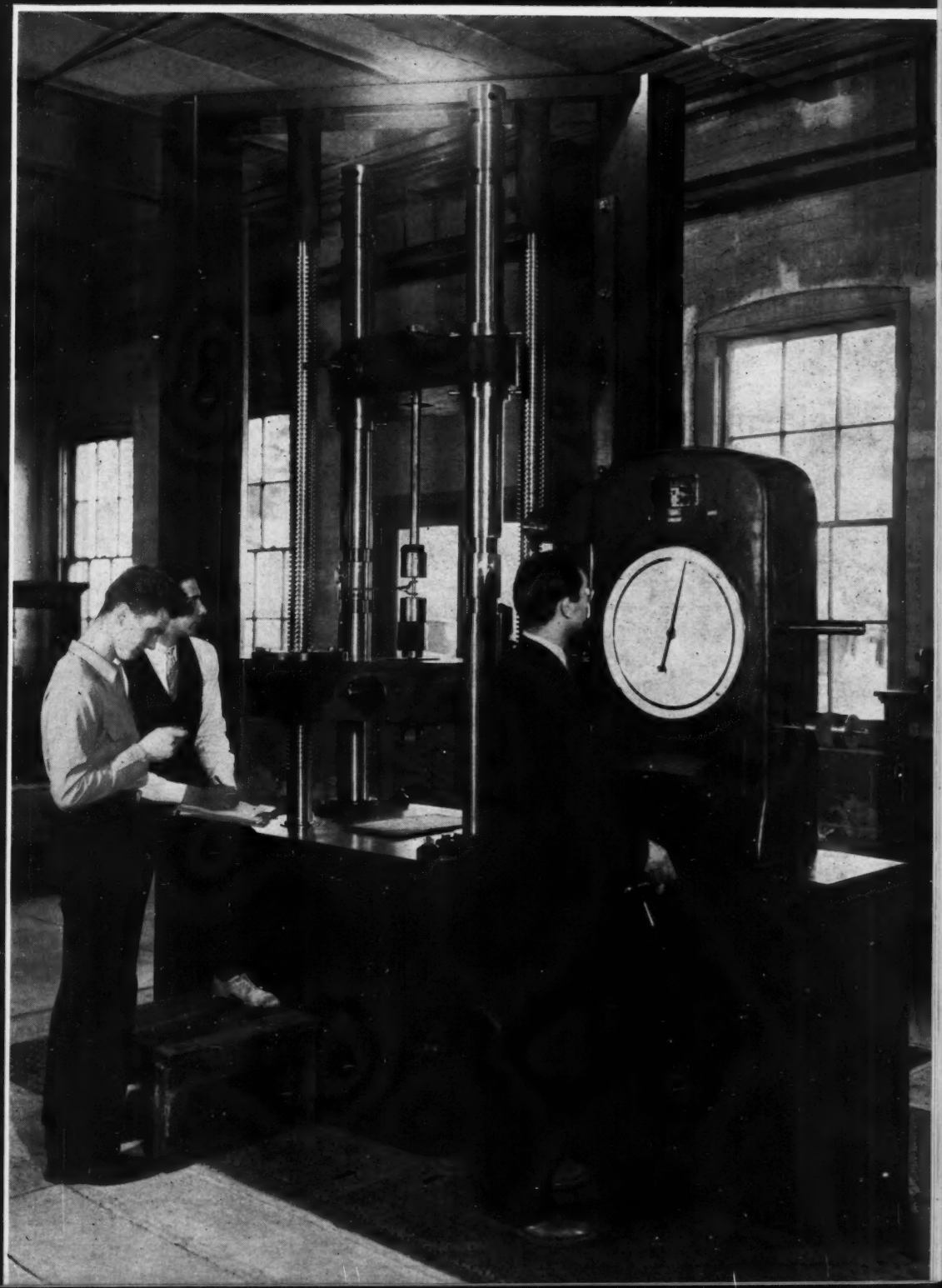

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✣ Among Our Authors

DEAN ALBERT W. SMITH, BME '78, has been well known by Cornellians for many years because he has been on the campus much of the time since he came to Cornell as a freshman in 1874. He took his MME in 1886 and became Assistant Professor of Mechanical Engineering in 1887, and Professor of Machine Design in 1891. In 1892 Professor Smith left Cornell to become Professor of Mechanical Engineering at Stanford University, returning to Cornell in 1904 to be Director of the Sibley School of Mechanical Engineering. From 1915 until 1921 he was Dean of Engineering, and was acting president of the University in 1920-21.

GLENN B. WOODRUFF, CE '10, who tells us about the Bay Bridge Railway, has had a great deal of experience with bridges. Upon graduating from Cornell, he spent a year working for the American Bridge Company, several years working as a bridge engineer for the Lehigh Valley Railroad, and shorter periods working for Ohio Fuel Supply Company, the Northern Pacific Railway, the Chile Exploration Company, and the Southern Pacific Railway. For 6½ years until May 1930 he was employed by the firm of Modjeski & Moran in charge of the designing of numerous large bridges throughout the country, including the $6,000,000 Mid-Hudson Bridge and the $15,000,000 Public Belt Railroad Mississippi River Crossing at New Orleans. Since 1931, Mr. Woodruff has been engineer of design of the great San Francisco-Oakland Bay Bridge, concerning which he writes.

ROBERT MANN, Ad. Eng. '39, obtained the material for his article largely from his experience working for the Jones and Laughlin Steel Company in Pittsburgh last summer. He is one of the more prominent engineers on the campus, being a member of Tau Beta Pi, and Kappa Tau Chi, honorary engineering societies.

A. RUSSELL VOLLMER, CE '27, who describes the design of grit removal structures for the city of Baltimore, has had a number of years experience with municipal water and sewage projects in Maryland, Virginia, and New York State. Following graduation, he was City Engineer of Ocean City, N. J., for two years, and since then he has been employed by Whitman, Requardt & Smith, Consulting Engineers of Baltimore and Albany. While in Baltimore, Mr. Vollmer was in close contact with the design of the grit removal structures of which he writes. At the present time he is in Albany working on sewage treatment plants for Glen Falls and Hudson Falls, N. Y.

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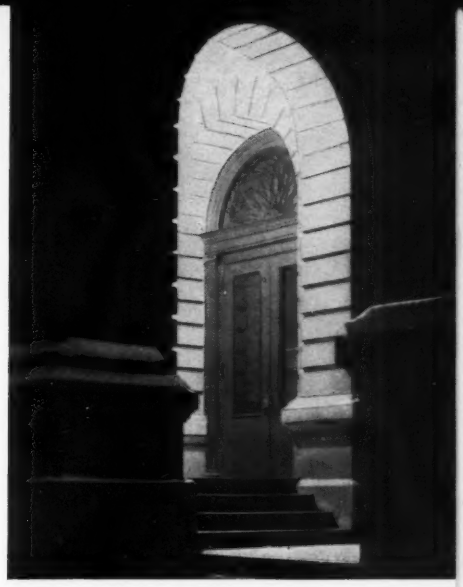

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Published monthly—October to May—by undergraduates of the College of Engineering, Cornell University. Entered as second class matter at the Post Office at Ithaca, N. Y., under section 103, Act of October 3, 1917.

Subscription per year: regular $1.50; with membership in the Cornell Society of Engineers $2.00. see President's page. Student $1.00; single copy $.20.

"SANDY"

Tau Beta Pi Prize Essay

By ROBERT MANN, A.E. '39

In the summer of 1937 the American monster, steel, awoke from its lethargy. Day and night its hot breath belched forth, lighting the sky and fouling the air. At the Alquippa works of J&L the glow of Bessemers and hot metal was reflected in the busy Ohio, and with it a glow of hope in the eyes of long idle men. Steel was alive, Alquippa was alive, and men once more hoped and planned.

It was there I met Sandy. Sandy was a big man with a big smile, and a still bigger heart. To J&L Sandy was a "Millwright's Helper, at 65c an hour," and No. 17015 on the company list. Steel was big.

Steel was too big for Sandy to worry about it. To Sandy, steel meant his foreman, the other nine men in his gang, and his bi-weekly pay envelope. With these he was happy; with these Sandy was big.

Sandy's happiness was evident in his work. He whistled. When the load on the pinch bar or the drive of the sledge cut short his whistle, he just grinned. At such times ignorance radiated from his countenance. But Sandy had a song in his heart.

For this reason I took a shine to Sandy and soon we worked together. With Sandy the days were shorter for me, the sledge felt lighter. Sandy put life and exuberance into his work. The other men felt it and envied him.

Our work was varied. We moved about the mill, one day setting new machines, another day tearing out or repairing old ones. Always Sandy's broad back was beside me as he breathed life into his work. No man in the gang had Sandy's power. In hot weather the sweat would form in rivulets between the ridges of muscle on his back and shoulders. The heavy tasks were Sandy's and he made them light.

And his heart was big. While others rested awaiting the lowering of the machine onto the bolts, Sandy would help the riggers. Their ropes and blocks sung under his willing effort, and the riggers envied Sandy.

July and August slid by. September came, and with it my last day at work. It rained that day, but Sandy smiled. Our work lay in the new Temper Mill. A forty ton, four-inch stand was to be lowered onto its bolts. The Riggers were on hand to help steady and guy the descent. Sandy climbed into the pit with a sledge to tend the bolts. His lips puckered, and Annie Laurie echoed merrily from the pit. The forty ton stand swung lazily on its cable from the overhead crane. The craneman awaited the foreman's signal. It was an everyday job. Sandy was whistling when the crane hook broke and the others jumped clear. He must have been whistling when the stand struck him.

When I left the mill it was dark out, and the rain droned monotonously on the steel roofs. Three miles away the Bessemers glowed through the dirt and fog. Steel was big. But Sandy was bigger. He had a song in his heart.

●

ED. NOTE.—This essay, which won the Tau Beta Pi prize in the competition open to the fall electees, is based on an actual occurrence at the Alquippa Works of J&L. We are all watching its progress in the national competition for a grand Tau Beta Pi prize, Bob, for we like it.

Frontispiece—A general view of the rolling mills of the Republic Steel Corporation.

—Courtesy of "Architectural Forum"

BALTIMORE GRIT REMOVAL CHAMBERS

By A. RUSSELL VOLLMER, C.E. '27

The grit chambers, now under construction for Baltimore, Maryland, at the Back River Sewage Treatment Works, furnish an example of tanks designed on the basis of sedimentation theory and equipped with one of the present standard types of continuous grit removal mechanisms. A view, in aerial perspective, of the finished structures is given in Figure 1. No great variations from the generally accepted empirical values for horizontal velocity and detention period were adopted, although the design was primarily guided by the principle that sufficient surface area should be provided to allow satisfactory removal of the various sizes of grit particles carried by the incoming sewage during maximum flows. Use was made of established relationships between particle size, settling velocity and proportion of removal. The application of these relationships to the design will be discussed in this paper.

Grit removal is that process in sewage treatment which provides for the elimination of sand, grit, and other heavy non-organic solids. Velocities and detention periods are such that lighter, less readily settleable, organic solids are not deposited in any appreciable amount, but are carried through the chambers to other treatment processes.

Grit removal will be a new step in sewage treatment at the Back River Works. It is part of an enlargement program which will include: additional primary sedimentation capacity; activated sludge works with appurtenant aeration tanks, final settling tanks, sludge concentration tanks, blowers, and accessories; additional sludge digestion capacity; sludge elutriation and vacuum filtering. The grit problem at Back River has been present for some time in spite of the fact that in Baltimore the sewers are separate from storm drains. Grit has been removed from the outfall sewer ahead of the coarse racks and from the influent end of the old manually cleaned primary settling tanks since 1928. The average quantity taken out of the system at these points during the ten year period ending with 1937 has been 2,371 cu. yds. per year. Since the installation of the mechanically cleaned primary settling tanks, grit which has been deposited in these tanks along with the sludge has caused clogging in the sludge piping. On a few occasions, the deposit of grit in these primary tanks has been sufficient to stop the collecting mechanisms and require dewatering and hand cleaning. Thus, the need for grit chambers has been definitely demonstrated by operating experience.

The chambers have been designed to treat a maximum flow of 300 M.G.D., the capacity of the outfall sewer . Although the average sewage flow for 1937 was 86.76 M.G.D., a peak rate of 242.5 M.G.D. was recorded during a period of unusually heavy rainfall. Flows in excess of 200 M.G.D. have been recorded at other times under similar conditions. This increase in sewage flow during storms is a characteristic which is common to a greater or less degree in all older separate sewerage systems. Storm water usually reaches the sanitary system by infiltration, inadvertent or illegal roof and storm connections, and by leakage through manhole covers. In Baltimore, part of this excessive flow in the sanitary system is caused by the connection of suburban sewers over which no previous control had been exercised. However, there is no altering of the fact that treatment plants must take what comes down the outfall, including grit and excessive flows.

The decision to install a continuous removal type of grit collecting and handling mechanism at the Back River plant made it necessary to design tanks suitable for the installation of one of the available makes of such equipment. Manufacturers of sewage treatment machinery have developed a variety of mechanisms for grit removal and each make of equipment introduces peculiarities which affect the shape and cross-section of the tank. This situation adds to the difficulty of selection and makes it necessary to establish a basis for the comparison of tank performance. Machinery for the continuous removal of grit usually employs some form of scraper which periodically sweeps the tank floor and drags settled matter to a removal

point. From this point the material is removed by means of rakes on inclined planes, inclined screw conveyors or buckets. All these types also provide a means of washing the settled material and releasing the organic solids that have been deposited with the grit. Two features of this type of mechanism affect the design of tanks. Continuous removal eliminates the necessity to provide grit storage space as part of the tank volume. The washing action of the removal mechanism makes it less imperative to maintain horizontal velocities for all flows at a figure which will prevent deposition of excessive amounts of organic solids.

Sedimentation becomes a complex problem when all the factors affecting the settling of particles of widely varying sizes and specific gravities are considered. The major factors which determine subsiding velocities are particle size and density together with liquid viscosity and density. The subsiding velocities of particles in still water have been found to fall into three broad classifications depending upon particle size. For particles less than 0.10 mm. (approximate) in diameter, the rate of settling is influenced mainly by the viscosity of the liquid and in accordance with Stokes Law; for particles over 1.00 mm. (approximate) in diameter, the rate of settling is influenced mainly by the frictional resistance of the liquid. Between these two groups is a transition region where both viscosity and friction are effective.

For a grit chamber design based on sedimentation theory, it is necessary to first restrict the discussion to particles of the sizes and specific gravities which such chambers are built to collect and then to utilize the settling velocities and expressions which apply to these particles. It is also necessary to make certain assumptions regarding the action of the particles and the liquid in order to simplify the problem and develop removal relations.

Sewage grit is composed mainly of sand and mineral particles ranging in size from approximately 0.10 mm. to larger than 1.0 mm. with a specific gravity of about 2.65. Particles with these characteristics when present in sufficient quantity make it necessary to provide grit removal equipment at sewage works. Sewage grit falls almost wholly within the transition region mentioned previously. Hazen in his well known paper "On Sedimentation" (Trans. A.S.C.E. 53, 45) reported the results of a careful study of the settling of quartz grains in this transition region and developed theoretical expressions for the removal of sediment using various basin arrangements. Reference is made to his paper for these expressions. The subsiding velocities of quartz grains (sp. gr. 2.65) in still water at 60°F. are given in Table I, which is based on experimental data by Hazen.

TABLE I

Diameter of Particle		Subsiding Velocity 60°F.	
		mm.	feet
inches	mm.	per sec.	per sec.
.039	1.00	117	.383
.031	.80	97	.317
.024	.60	73	.241
.020	.50	62	.203
.016	.40	49	.161
.012	.30	37	.122
.008	.20	24	.080
.006	.15	17	.057
.004	.10	9	.030

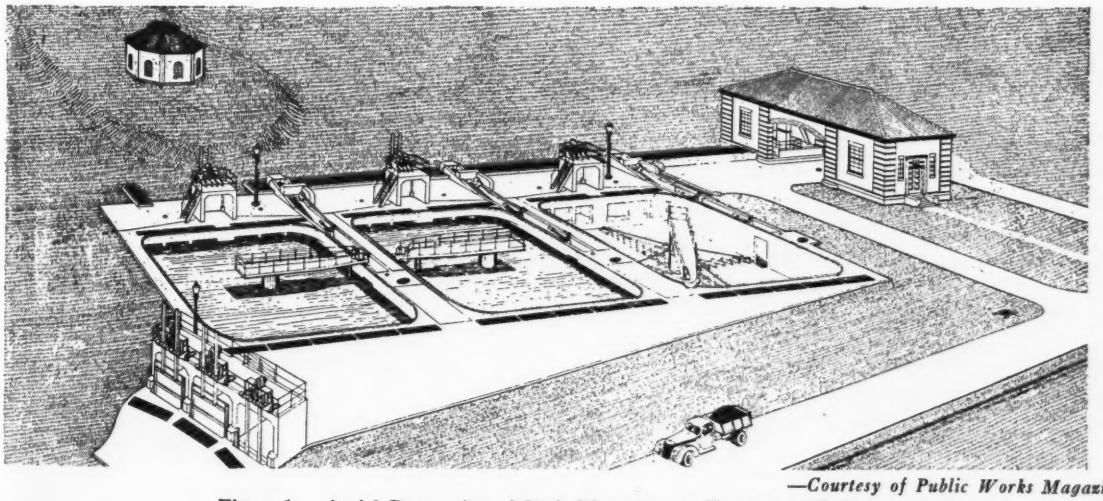
The assumptions necessary for the development of sedimentation expressions may be stated as follows:

(1). All particles maintain their shape, size and individuality during settlement. Each particle settles at constant velocity without interference.

(2). When a particle of sediment reaches the bottom, it is removed from the basin.

(3). The direction of flow is horizontal, and the velocity is the same in all parts of the basin.

(4). Particles of each size are evenly distributed from top to bottom throughout the incoming sewage.



—Courtesy of Public Works Magazine

Figure 1. Aerial Perspective of Back River Sewage Treatment Works.

It is apparent that any mathematical expressions for the removal of sediment based on the above assumptions, can only be completely true for an "ideal" basin, but such expressions may be used as a basis for the comparison of tank performance and as a measure of the sedimentation characteristics of an actual basin. In the design of any sedimentation tank, it is reasonable to require that the detention period for a given flow be at least sufficient to allow particles, for which removal is desired, time to settle from the top to the bottom. Under ideal conditions and in accordance with the above assumptions, if the time required for any one particle to settle from the top to the bottom or the time of sedimentation is equal to the detention period, particles of that size will be exactly 100 per cent removed and will be equally distributed over the tank bottom. Further, since the subsiding velocities for each particle are constant, those having a greater subsiding velocity will be 100 per cent removed in a shorter period and particles having lesser velocities will be removed in the ratio that their time of settling bears to the detention period. Hazen has pointed out that these removal proportions are a function of the area of the basin. For a given area and quantity of flow, the deposition of particles is independent of the depth. Of course, depths cannot be so shallow that the horizontal velocity will prevent the deposit of sediment.

The mathematical development of the foregoing statements for the removal of sediment in an ideal basin may be demonstrated as follows:

$$\text{If } a = \text{detention period} = \frac{\text{capacity of basin}}{\text{quantity per unit of time}}$$

b = basin area

h = depth

c = capacity

e = quantity treated per unit of time

v = subsiding velocity

t = time of sedimentation or time required for one particle to settle from top to bottom.

a/t = detention period in terms of time required for one particle to settle from top to bottom.

then $a = c/e = bh/e$

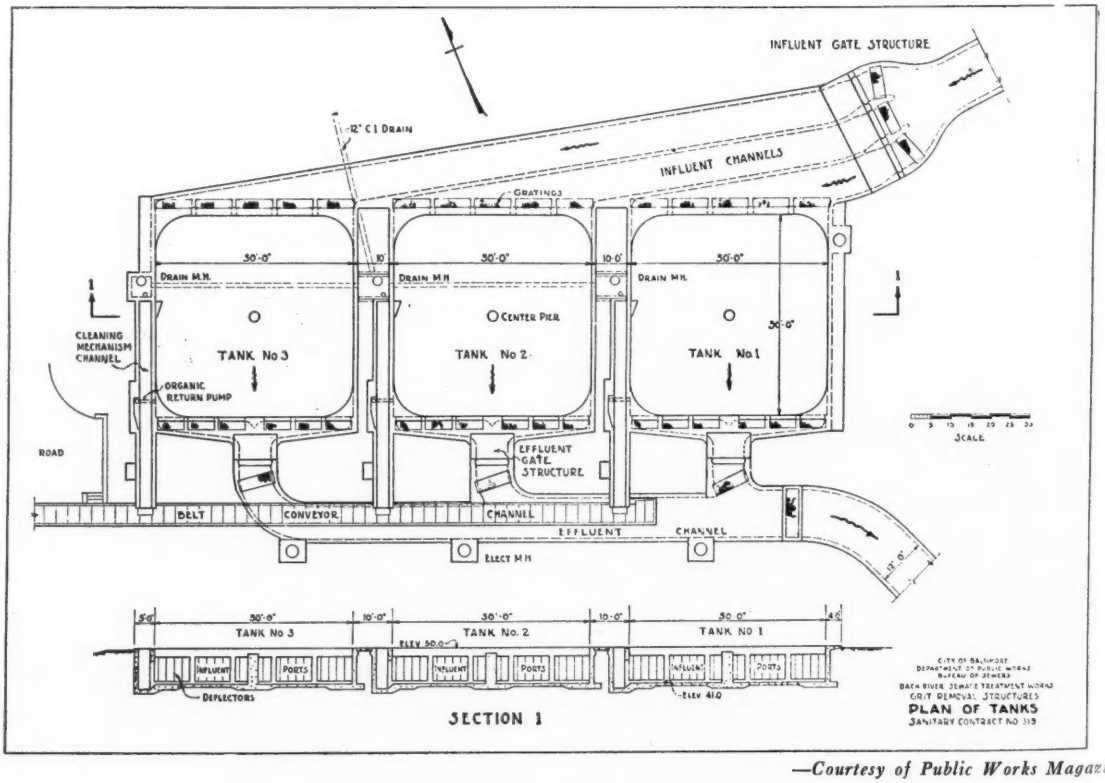
$t = h/v$

and $a/t = bv/e$

Values for a/t are thus independent of the depth and they may be combined for a given flow and particle size if a definite area is assumed. Values for bv/e which make a/t equal to or greater than 1.00 indicate 100 per cent removal in an ideal basin and values which make a/t less than 1.00 indicate partial removal in the ratio of a/t. In any basin the removal of grit is some function of a/t.

One other expression was used in comparing sedimentation characteristics. If one basin is operating continuously, with liquid being admitted at one place and drawn off at another, the expression for the proportion of sediment remaining in the liquid after the process is the reciprocal of $1+a/t$. This expression is based on the assumptions that the density of suspended matter is kept the same in all parts of the basin

(*Continued on page* 26)



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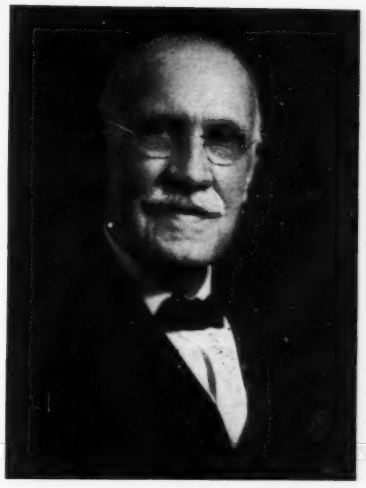
Suggestions For Forming The Reading Habit



By Albert W. Smith, B.M.E. '78

Dean Emeritus of the College of Engineering

It is desirable first to find out one's inborn preferences in reading, if they are not already known, and then to follow these preferences with growing enthusiasm, and with increasing breadth of outlook on the literature which is the illuminated record of life.

It should be kept in mind always that reading that is to liberalize should stimulate thought and emotion; for it is through exercise of the mind and heart that one grows in power for wise and upright living. The reading which is forgotton overnight may—like playing solitaire—be useful for restful diversion, but it does not help to build character.

To test native taste in reading, a good method is to select an author for trial, with the aid of more experienced readers; if this author has written in several forms of literary art, make a selection from each and read it carefully. These readings will usually make it clear to the reader whether or not he wishes to continue with this author.

Robert Louis Stevenson may be taken for illustration. To test adventure tales, read "The Beach of Falesa" in the volume, "Island Nights Entertainments"; or "The Pavilion on the Links" in the volume, "New Arabian Nights"; or the longer story, "Ebb Tide". If these tales tend to keep one awake nights with thrilling interest, they might be followed by "Kidnapped" and "David Balfour". For romance, read "Prince Otto" or "The Black Arrow". For gruesome tales, "Markheim" or "Doctor Jekyll and Mr. Hyde."

If the reader has followed thus far, he will surely know whether he wishes to go on.

If Kipling is the chosen writer, one should read some of his earlier stories of India; especially "The Man Who Would Be King" or "Without Benefit of Clergy", or the longer story, "Kim". One might try Kipling's poetry by reading "The Explorer", or "The Sons of Martha", or "The Bell Buoy". Or, from "Barrack-Room Ballads", "Gunga Din", "Fuzzy Wuzzy", and "Danny Deever".

Here follow miscellaneous suggestions from various authors:

Joseph Conrad: "The Planter of Malata" in the volume, "Within the Tides"; "Youth"; "The Rover".

Frank R. Stockton's whimsical stories, especially, "A Tale of Negative Gravity".

George W. Cable: Any of the short stories in "Old Creole Days".

H. C. Bunner: Any of the stories in "Short Sixes".

William J. Locke: "The Joyous Adventures of Aristide Pujol".

John Galsworthy: Any of the stories in the volume, "Caravan".

J. M. Barrie: Any of his plays.

Leonard Merrick: Any of his short stories, or "Conrad in Search of His Youth".

Maurice Hewlett: "Little Novels of Italy".

James Lane Allen: "King Solomon of Kentucky", in the volume, "Flute and Violin".

Donn Byrne: "Blind Rafferty".

J. A. Mitchell: "The Pines of Lory".

Jane Barlow: "Stopped on Signal", in the volume, "Maureen's Fairing".

In somewhat earlier times;

Walter Scott: "The Heart of Mid-Lothian", "The Antiquary".

W. M. Thackeray: "Henry Esmond", "Vanity Fair".

Charles Dickens: "Tale of Two Cities", "Our Mutual Friend".

George Eliot: "Silas Marner".

A reader should get from his reading an understanding of human motive and action; not only in the present, but in other times and places. The narrow man is he who knows only about his neighbors of today and yesterday. The broad man has learned something of older civilizations. It is not necessary to read the records of these peoples in the language in which they were written, for all that is best is available in excellent English translations.

Homer's "Odyssey" has been called: "The greatest story in the world"; hence it must be worth reading. A translation by Butcher and Lang is available through

(*Continued on page 23*)

San Francisco's Bay Bridge Railways

By Glenn B. Woodruff, C.E. '10

The design of the railway facilities of the San Francisco-Oakland Bay Bridge involved several unique problems and afforded an opportunity to introduce the latest developments applicable to electric railways. The project involved all phases of engineering. For the civil engineer, there were problems in structures, railroads, sanitation, and hydraulics; for the mechanical engineer, those in rolling equipment and the heating and ventilation of buildings; and for the electrical engineer, problems in power conversion and transmission, railway signaling, telephony, and lighting. In describing the project, emphasis is placed on those elements involving new practices.

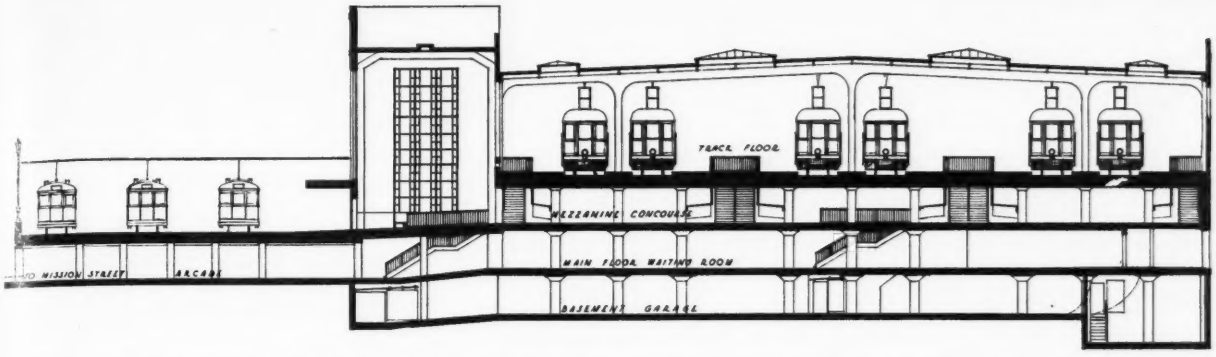
Interurban passenger service between San Francisco and the East Bay Cities of Oakland, Alameda, and Berkeley is conducted by two companies, the Southern Pacific and the Key System. They operate ferries from the San Francisco Ferry Building to piers on the east side of the Bay, where the passengers transfer to electric trains radiating to various parts of the East Bay. A third company, the Sacramento Northern Railway, operates a suburban line to the north, reaching San Francisco by means of rights on the Key System tracks and ferries. The project, now nearing completion, provides for the elimination of this ferry service (vehicular ferries still remain in operation) by bringing the trains across the bridge to a terminal in San Francisco. This change will reduce the average time per passenger trip from 45 to 37 minutes.

The maximum recorded traffic was in 1924 when these three Companies carried nearly 40 million passengers. After that time, increased fares on the interurban trains, increased competition from the automobile, and the business depression resulted in a reduction of traffic, so that in 1936, at the time of opening the bridge for vehicular operations, the annual traffic was only 26,000,000 passengers. After the start of bridge operations and a drastic cut in vehicular ferry tolls, there was a further drop in interurban traffic to 20,000,000 passengers annually. It is estimated that the improvement in service made possible by the bridge will result in a large increase in traffic. For this reason, and to cover future increases, the design of the railway facilities has been made on the basis of an annual traffic of 50,000,000 passengers with a 20-minute peak of 17,000 passengers in one direction. This peak, on the basis of a seat for every passenger, would require 10-car trains operating on a 65-second headway. At the start of the operation, there will be, in the peak period, 16 trains in a 20-minute period, or a 75-second headway. Since the bridge provides only a single track in each direction, it was necessary to design all other facilities so that there may be no delays to trains about to enter or leave the tracks on the main bridge.

Description of Bridge Railway

The bridge railway consists of the San Francisco Terminal, a viaduct between the Terminal and the main bridge, the trackwork and other facilities on the bridge, a storage yard and shop facilities at the east end of the bridge, and the connections to the existing lines in the East Bay. The work has also included extensive alterations to the equipment of the railroads that will use the bridge, and three substations for the conversion of the necessary power.

The San Francisco Terminal is of the loop type. (Fig. 1.) Trains leave the bridge at the top of Rincon Hill and are alternately switched to one of the two incoming tracks. By this means, the slower speeds necessary on the curves in the loop do not cause the backing up of trains on the bridge. The controlling thought in the layout of the terminal was to produce the most direct route for the passenger between the train and street exit. To this end, the resulting design is largely a system of ramps and stairs connected by transverse concourses at the mezzanine level. The station has six tracks with four platforms 780 feet long. It is divided by two transverse streets, First and Fremont,



Cross section of Terminal. Building is cut into three units by two transverse streets over which only the track floor crosses. Street cars, at left, rise to the mezzanine level by ramps.

into three units, the streets being crossed by the track level only. Each of the track platforms is reached by ramps and stairs from a mezzanine concourse in each of the three units. The terminal faces Mission Street, one block from Market Street, the latter being San Francisco's principal business thoroughfare. Street cars leave Market Street at First Street, come to the terminal, ramp up to the mezzanine level, and return to Market via Fremont Street. Except for the steel roof framing, the terminal is of reinforced concrete flat-slab construction. The Mission Street facade is faced with granite and the interior trim is of tile.

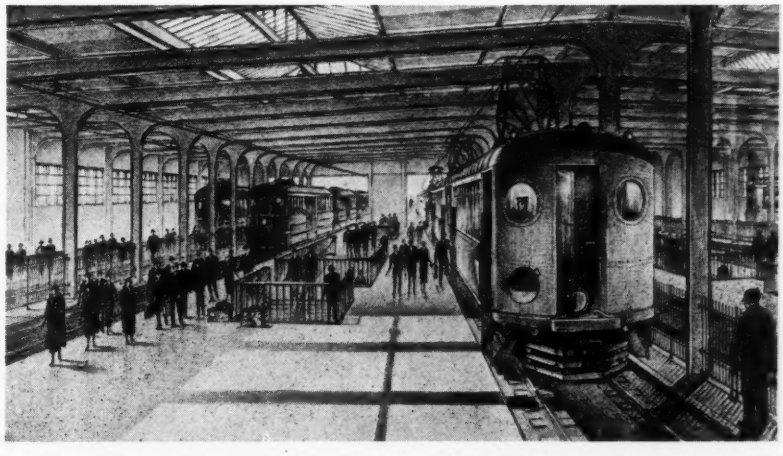
The viaduct between the terminal and the main bridge consists, mainly, of a series of reinforced concrete rigid frame structures with clear spans varying from 60 to 85 feet. To avoid the falsework that would be required for concrete spans, steel girder spans were used over several of the more heavily traveled streets. Steel spans were also used at the east end of the loop where unsatisfactory foundation conditions made it desirable to keep the foundation loads to a minimum.

The East Bay Yard covers an area of 43 acres. Part of this area was originally reclaimed by the Key System as part of their route to their East Bay Terminal. The present project involved further reclamation to the extent of importing 310,000 tons of sand and gravel, and the construction of a rip-rap seawall along the south side, the north side being along the vehicular approach to the bridge. In this yard, there are storage tracks for 228 cars, in addition to two "set-out" tracks 720 feet long in each direction for each of the two companies, and the main tracks. When trains are to pick up or drop cars, they will be routed through the set-out tracks. Automatic couplers on the trains will permit cars to be dropped without a stop, and in adding cars, trains will stop only momentarily. Also, in this yard are located inspection buildings 75 x 340 feet for the Southern Pacific; 80 x 370 feet for the Key System; the Oakland Signal Tower; and a number of smaller buildings. Bridge structures in this area include a four-lane highway bridge over the yard, a single-track viaduct carrying the westbound Southern Pacific track over the Key System eastbound main track, and a double-track viaduct carrying the Southern Pacific tracks over the main line (transcontinental) of the latter company.

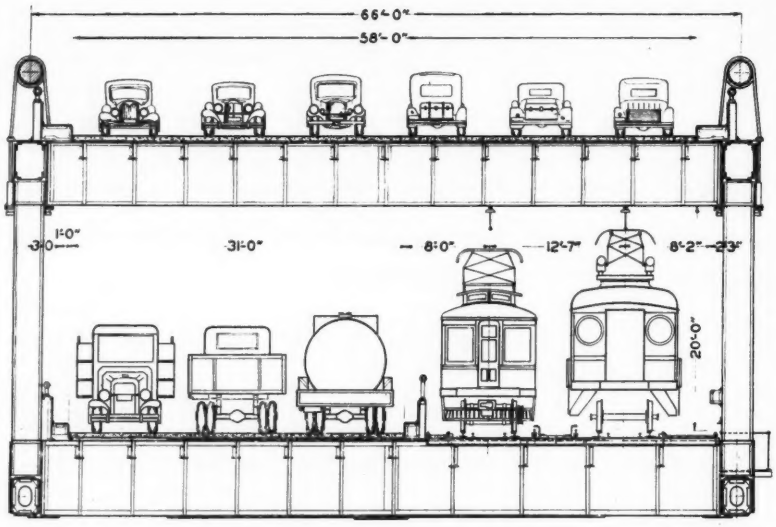
Trackwork

In general, the trackwork followed conventional practice; in detail, there were several complications. Ninety-pound rail was used throughout. On the bridge, open-deck construction was necessary to keep within the dead load assumed in the design. Redwood ties 8 inch x 9 inch on 12-inch centers, were used principally on account of the natural fire-resistant properties of this material. Except in panels adjacent to the floor expansion joints, 4-inch spacer blocks, 12-inches long, are placed between the ties under each rail to prevent bunching of the ties. To insure the best track surface and equal bearing of each tie, profiles were run over each stringer for the entire length of the bridge, each tie dapped to the nearest eighth of an inch.

A detail that gave considerable concern was that



View along track level of Terminal, showing steel rigid frame roof construction.



On the bridge, the trains will operate on the lower deck with Southern Pacific cars powered from a catenary system and a third rail for the Key System.

of the track expansion at the towers of the West Bay suspension spans and at Tower E-4 of the East Bay Crossing, at which latter point the expansion for practically a mile of bridge is concentrated. These joints required provision not only for a horizontal expansion of 19½ inches from the mean position, but also for changes in vertical and horizontal angles resulting from the vertical and horizontal deflections of the structure. Furthermore, to prevent shunting of the signal circuits, the rails had to be insulated from each other; and to keep the return propulsion current insulated from the bridge, the entire assembly was insulated from the steelwork of the bridge. The total 39-inch motion was more than was considered advisable to take at one point; hence, the rails were cut in two places and the expansion evenly divided between the two points by an equalizing lever. A continuous guage was obtained by an outer curved rail held to guage by guides, sliding against a fixed point rail. Continuous guard rails are secured to the sliding plates, and opposite the sliding point of the track rail, this guard rail is replaced by an "easer" which slightly lifts the wheel above the point.

At either end of the San Francisco Terminal, there is the usual throat arrangement so that incoming or outgoing trains may enter or leave any of the station tracks. In this particular case, the layout was complicated by the 20-degree curves so that most of the 40 switches and frogs in this area were curved. Both as a precaution against derailment and to reduce rail wear on these sharp curves, a safety 110-lb. guard rail was placed adjacent to the low 90-lb. running rail with a flangeway of 1⅝ in. To secure the best possible alignment and to reduce the amount of field bending and drilling, both the running and guard rail were bent, drilled, and match-marked in the shop.

Through the San Francisco Terminal, the rails are spiked to wooden blocks embedded in concrete. This concrete is insulated from the structural concrete by two 1-inch layers of asphalt-impregnated cane fiber.

Power Distribution System

The power distribution system is complicated by the fact that Southern Pacific trains operate on 1300-volt catenary, and the Key System on 625-volt catenary. The Sacramento Northern can operate on either voltage. Preliminary estimates of the cost of the power system and of the cost of changes to equipment were made on the bases of 625-volt operation with change-over equipment for the Southern Pacific cars; 1300-volt operation with change-over equipment and new motors and control for the Key System cars; and "dual-voltage"; providing, on jointly-operated tracks, 1300-volt catenary for the Southern Pacific and 625-volt third rail for the Key System. The latter system was adopted.

Electrical energy at 12 kv. will be supplied to three substations; "Sterling", where the bridge railway joins the main bridge; "Mole", at the east end of the bridge; and "Island", on Yerba Buena Island. At the Island substation, conversion will be to 625 volts only; at the others, to both 1300-volts and 625-volts. All new conversion equipment are mercury arc rectifiers, the installed capacity at each of the three substations being as follows:

Sterling Two 2500-kw. 1300-volt mercury arc rectifiers.
Two 2000-kw. 625-volt mercury arc rectifiers.
Island Two 200-kw. 625-volt mercury arc rectifiers.
Mole Two 2500-kw. 1300-volt mercury arc rectifiers.
Two 1000-kw. 625-volt mercury arc rectifiers.
One 1500-kw. 625-volt motor generator (existing).

The rectifiers have such overload characteristics, (4 times momentary; 3 times, 1 minute; 2 times, 30 minutes; and 1½ times, 2 hours,) that this installation affords very large capacity in the peak periods. In addition, the east end of the yard will be fed from the Key-Yerba Buena Station and the Southern Pacific-West Oakland Station, which stations now supply power for the existing service.

The required conductivity for power distribution was generally placed in the contact system so as to eliminate feeders. The standard main line overhead is made up of one main messenger, hard-drawn copper, 500,000-c.m.; one intermediate messenger, h.d.c.-4/0; two contact wires, 80 percent conductivity bronze-4/0. This combination has a copper equivalent of 1,023,000 c.m. On the westbound track uphill and on the eastbound track uphill from the Mole and Sterling Sub-

stations, respectively, an additional 500,000-c.m. messenger was introduced into the system. Somewhat lighter combinations are used in the yard and through the terminal. The 625-volt contact rail, adjacent to the main tracks, is 150-lb high-conductivity steel with a copper equivalent of 2,730,000 c.m. This was reinforced by 3,000 feet of 1,000,000-c.m. copper on the eastbound track from the Sterling Substation. Fifty-five-pound contact rail is used in the terminal area.

Both the 1300- and 625-volt systems are sectionalized at half-mile intervals at the terminal, Sterling Substation, center anchorage, Island, East Bay Crossing, the center of the yard, and the east end of the yard. The arrangement is such that a faulty section will be automatically cut out with power remaining on all other sections.

The negative or return propulsion current returns through the running and steel guard rails. Each joint in these rails is bonded with two 250,000-c.m. copper bonds, gas-welded to the head of the rail.

Signals and Interlocking

The proposed operation, on 3 percent grades, of 10-car trains on a 65-sec. headway is without precedent and is feasible only with the latest developments in railway signaling, employing four-indication cab signals with train-control devices. Duplicate motor generator sets located at the Mole Substation furnish energy to the 2300-volt signal power line at a frequency of 100 cycles. This line runs the entire length of the bridge railway over duplicate 2-conductor cables. At frequent intervals, a line transformer steps the voltage down to 110 and track transformers step this down as required for each track circuit.

The installation consists of an automatic block system with double-rail track circuits and using reactance bonds at the insulated joints to provide a path for the negative return of the power current. The occupancy of a block affects the controls of the blocks in its rear in the usual manner by interrupting the 100-cycle signal current in the rails, the rate of interruption in each block depending on its distance behind the occupied block. On down-grade portions of the bridge where braking distances are greatest, the blocks are 507 feet long. Four clear blocks ahead are indicated by 180 interruptions; two or three clear blocks by 120 interruptions; and one clear block by 75 niterruptions per minute. Occupancy in the next block ahead or in the immediate block is denoted by a steady current or by no current.

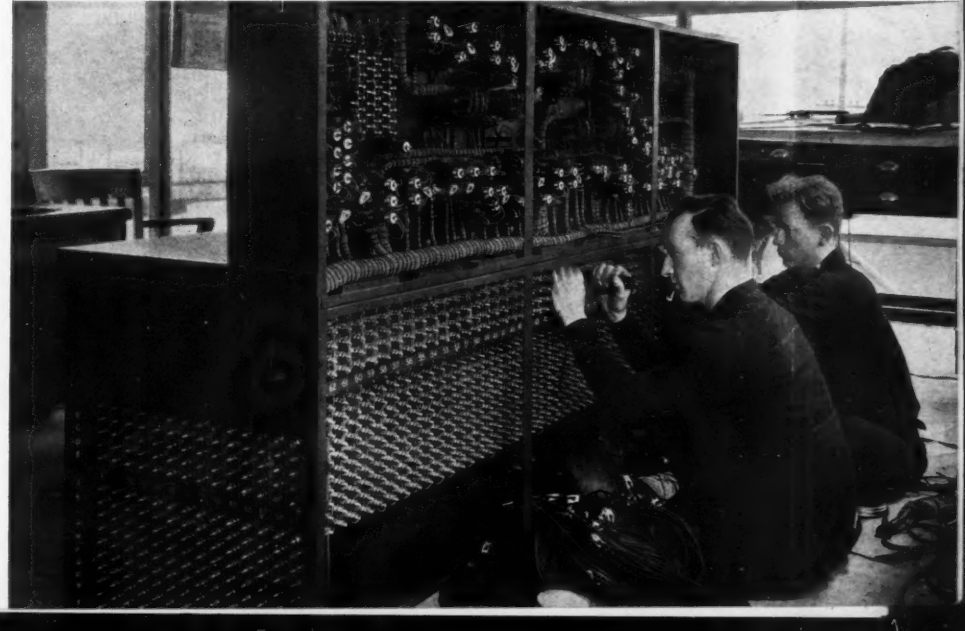
In place of the conventional semaphore wayside signals, the cab-signal unit is mounted directly alongside the front window of the operator's cab on each train. This unit indicates by illuminated colored numerals, which of the four authorized speed limits is in control. A speed governor mounted on the car axle operates a group of electric contacts connected in circuits to the cab-signal and braking equipment. A pair of receiver coils mounted at the head end of the train, in front of the first axle and about 6 inches above the rails, pick up the signal current by induction. The received current is filtered and amplified and the rate of interruption picks up the responding relay on the train, thereby selecting the cab-signal light and the set of governor contacts which will remain in control as long as the same code continues to be received.

The designed arrangment of codes and controls is as follows:

Code Rate Per Minute	Cab Signal Aspect	Authorized Speed M.P.H.	Speed above which white light is on in M.P.H.	Speed above which warning signal is sounding in M.P.H.	Speed at which emergency brakes are automatically applied in M.P.H.
180	Green 35	35	35	36	37
120	Yellow & Green 25	25	25	26	27
75	Yellow 17	17	16½	17½	18½
None	Red 11	11	10¾	11¾	12¾

As noted in the above table, a white light is shown when the authorized speed is reached. When this speed is exceeded by 1 M.P.H., a warning whistle is sounded, and upon a further increase of 1 M. P. H., there is an automatic emergency brake application.

When the cab signal changes to a more restrictive aspect, the operator is allowed 2½ seconds in which to make a full service brake application. When a Red 11 is received, an additional distinctive signal is sounded and the operator is required to press an "acknowledging" lever within 2½ seconds thereafter, or before moving the brake handle from the service position. Any



Rear view of N-X control board showing complicated wiring system.

failure to comply with any one of these requirements will result in an automatic application of the emergency brakes. Both wayside and car circuits are so designed that any defect or failure in the equipment will result in a more restrictive control rather than permit any unsafe operation.

All tracks in the San Francisco Loop and all main and set-out tracks in the East Bay Yard are interlocked, the switches being electrically operated and controlled from the towers. The control machines are of the recently developed "N-X" (entrance-exit) type and are the largest installation of this form. The various controls and indications are etched directly on the control board, so that memorizing of lever numbers and their relative functions are not required. Occupancy lights on the track diagram show the position of such trains as may be within the interlocking territory.

To "set up a route"; i.e., to operate the proper switches and clear the signals, it is only necessary to push the initiation button at the entrance to the route and the completion button at the exit of the route. As soon as the switches are in their proper positions, the signals will clear. The train passes through, restoring the signals to "stop" and releases each switch for a successive operation as soon as the train passes out of its block. In many cases, there may be two or more possible routes between the points indicated by the buttons. In case the usual route is blocked, the machine will automatically select a second or third route.

At the right end of the board, there is a system of train-describer lights. Key System trains are identified by a series of letters, A to H; Southern Pacific trains by a corresponding series of numbers. As the tower man sets up a route for a train to leave the San Francisco Terminal, he presses an identification button which results in transmission to the Oakland machine in such a way that the three rows of lights identify the next three trains to enter the interlocking. The Oakland tower man performs a similar operation so that the San Francisco tower man is advised of the train sequence. This information is necessary so that trains

Bay Bridge with San Francisco Rail Terminal in left foreground. Two tracks bridge. San Francisco Ferry building at extreme left. Yerba Buena Island left. Key System East Bay Ferry Terminal at right of bridge beyond Island in center background with Oakland ar

THE OLD

A mechanical lever system would have required 92 levers and a 60-foot switch tower.

foreground. Two tracks for W.B. trains in center. Three tracks from junction to ft. Yerba Buena Island in center with Treasure Island, site of 1939 Exposition, at of bridge beyond Island and Southern Pacific terminal in upper right. Berkeley kground with Oakland and Alameda to left.

may be placed on the proper tracks in the Terminal and placed on proper routes in leaving the East Bay Yard.

Structures

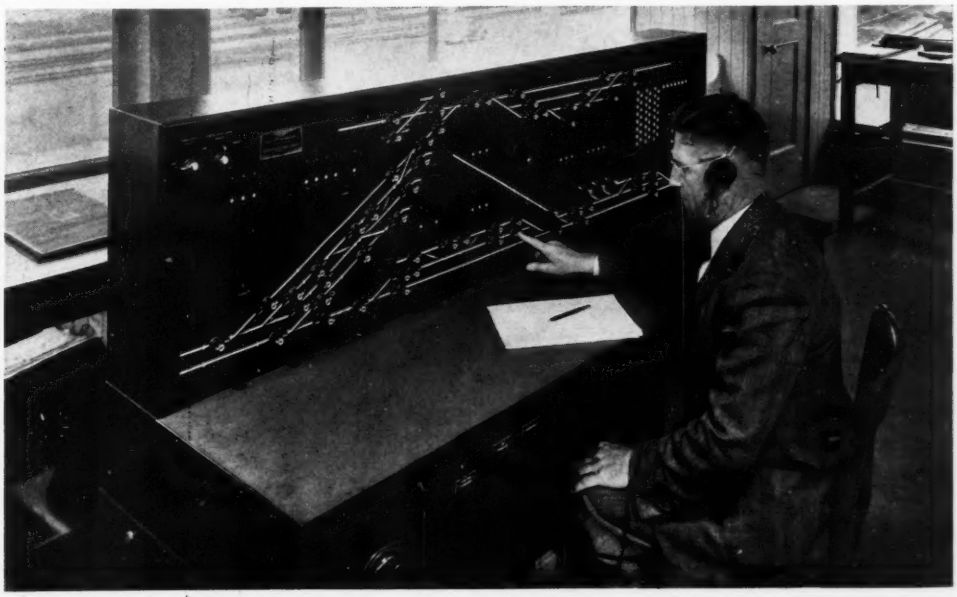
The greatest departure from standard structural design has been the use of rolled sections in rigid steel frames for the roof of the Terminal and for the catenary bridges. This has been principally to avoid the use of light members and lacing bars which are expensive to maintain. Arc welding was used to a large extent in the fabrication of these members. Also, in the Terminal, continuous girders with a curved bottom flange were used to reduce the depth of construction to a minimum.

Alterations to Equipment

As compared to the previous operations, service over the bridge required cab-signal control, automatic couplers, improved airbrakes, and motorization of several Southern Pacific trailers. The original Southern Pacific equipment was fairly modern, and for that Company, only the above-mentioned and other minor alterations were required. The modified equipment will consist of 95 motor cars, 15 operating trailers, and 35 non-operating trailers. The original Key System equipment was less satisfactory and complete rebuilding was undertaken. The result was 88 two-body articulated units, 23 of them completely new save for automatic couplers and pantographs; the remainder was largely, except for the bodies, constructed from alterations to the Sacramento Northern equipment materials salvaged from the previous equipment. They consist of cab signals and field control on 17 motor cars.

Personnel

The San Francisco-Oakland Bay Bridge is being built under the auspices of the California Toll Bridge Authority by the State Department of Public Works. C. H. Purcell is Chief Engineer, Chas. E. Andrew, Bridge Engineer, and the writer Engineer of Design. Among those who have represented the railways have been the following Cornell engineers: C. R. Harding, C.E. '10, Assistant to the President, Southern Pacific Company; H. P. Bell, M.E. '10, Vice-President and Chief Engineer, Key System; and Walter Evans, M.E. '06, Electrical Engineer, Sacramento Northern Railway.

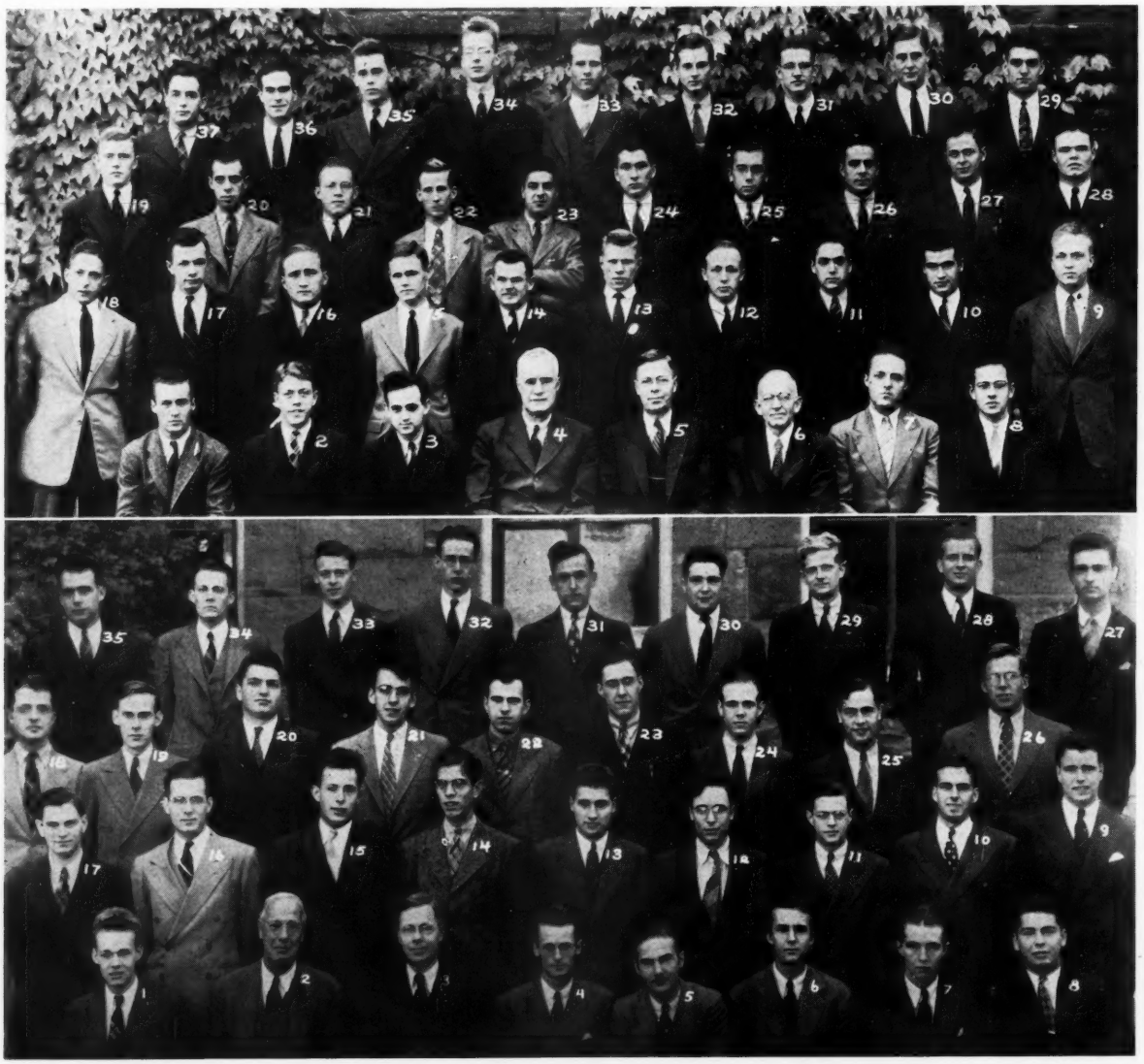


THE NEW

N-X control board 6½ feet wide operating electric routing and switching of Bay Bridge trains.

Senior Class 1939 School of Civil Engineering, Cornell University

1 Jones, C.T. Beacon, N.Y.
2 Crosby, E.E. Ithaca, N.Y.
3 Aleck J. Buffalo, N.Y.
4 Malcolm, W.L. (Director)
5 Hollister, S.C. (Dean)
6 Burrows, Prof. E.N.
7 Curtis, F.C. Pleasantville, N.Y.
8 Nagel, R.H. Yonkers, N.Y.
9 Gildersleeve, O.D. Gildersleeve, Conn.
10 Hintgen, G.L. Bismark, N. Dak.
11 Dye, G.J. Ithaca, N.Y.
12 Vogel, W.F. Pelham, N.Y.
13 Kirk, L.R. Summit, N.J.
14 Schaaf, P.A. Buffalo, N.Y.
15 McChesney, H. Locust Valley, N.Y.
16 Saunders, D.A. Great Neck, N.Y.
17 Bogert, I.L. Binghamton, N.Y.
18 Blickman, N.A. New York City
19 Church, J.F. Titutsville, Pa.
20. Torti, P.R. Brooklyn, N.Y.
21 Bergquist, C.R. Jamestown, N.Y.
22 Thomas, D.N. Ithaca, N.Y.
23 Durant, L. Great Neck, N.Y.
24 Steele, J.M. Philadelphia, Pa.
25 Cormack, B.L. Buffalo, N.Y.
26 Kheel, J. New York City
27 Bennett, E.F. Rockville Center, N.Y.
28 Fleming, W.J. Jackson Hts., N.Y.
29 Harger, C. Rochester, N.Y.
30 Fairback, D. St. Louis, Mo.
31 Genung, L.M., Cortland, N.Y.
32 Beve, C.E. Stockholm, Sweden
33 Scott, W.H. Omaha, Nebr.
34 Tammen, J.G. Short Hills, N.J.
35 Dirlam, J.K. Corning, N.Y.
36 Livingston, F.M. Greenwich, Conn.
37 Page, W. Slaterville Springs, N.Y.



Senior Class 1939 School of Electrical Engineering, Cornell University

1 Knudson, L.I. Ithaca, N.Y. (E.E.)
2 Lincoln, P.M. (Acting Director)
3 Hollister, S.C. (Dean)
4 Harries, E.E. Buffalo, N.Y. (A.E.)
5 Papez, J.P. Ithaca, N.Y. (E.E.)
6 Warrick, W.H. Detroit, Mich. (E.E.)
7 Woodward, C.P. Coxsackie, N.Y. (A.E.)
8 Gifford, R.M. Cleveland Hts., O. (A.E.)
9 Lentz, W.P. Baltimore, Md. (E.E.)
10 Edgerton, N. Lynbrook, N.Y. (E.E.)
11 Wolff, J.C. Woodmere, N.Y. (A.E.)
12 Moody, N.K. Tulsa, Okla. (E.E.)
13 Rhodes, C.F. Clark Mills, N.Y. (E.E.)
14 Birchenough, A.S. Skaneateles, N.Y. (E.E.)
15 Warner, B.C. Rochester. N.Y. (E.E.)
16 Yetter, J.W. Penn Yann, N.Y.(E.E.)
17 Mayle, A.T. Niagara Falls, N.Y. (E.E.)
18 Bryant, N.H. Greene, N.Y. (E.E.)
19 Hopkins, W.C. Hubbard Woods, Ill. (A.E.)
20 Urquhart, E.R. Ithaca, N.Y. (E.E.)
21 Nearing, H.H. Morris, N.Y. (E.E.)
22 Clark. S.E. Binghamton, N.Y. (E.E.)
23 Snowdon, T.L. Niagara Falls, N.Y. (E.E.)
24 Hawkins, R.S. Southold, N.Y. (E.E.)
25 Gregg, W.E. Baltimore, Md. (E.E.)
26 Whittlesey, S.E. Springfield, Mass. (A.E.)
27 Head, E.R. Kenosha, Wis. (A.E.)
28 Dungan, M.R. Orlando, Fla. (E.E.)
29 Roe, R.B. Buffalo, N.Y. (E.E.)
30 Gilkeson, R.F. Merion, Pa. (E.E.)
31 Humphrey, C.D. Buffalo, N.Y. (E.E.)
32 DeWitt, G.B. Ithaca, N.Y. (E.E.)
33 Moore, A.H. Ho-Ho-Kus, N.J. (E.E.)
34 Cunningham, E.W. Kirkwood, Mo. (E.E.)
35 Campbell, A.B. St. Albans, N.Y. (E.E.)

CORNELL SOCIETY of ENGINEERS

WALKER L. CISLER '22, President
80 Park Place, Newark, N. J.

WILLIS H. CARRIER '01, Vice President
Carrier Corporation, Syracuse, N. Y.

PAUL REYNEAU '13, Secretary and Treasurer
107 East 48th Street, New York, N. Y.

DAVID HARMON '31, Recording Secretary
21 Audubon Avenue, New York, N. Y.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

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President's Column

FELLOW ENGINEERS:

In the plans for the development of the Cornell Society of Engineers, no program is more important than the establishment, at the earliest possible moment, of active regional groups throughout the country. I look forward to the time when every large industrial city will be the center of such a group. I firmly believe that the time is past when the affairs of Cornell's 15,000 engineering alumni can be adequately handled in New York City alone.

Professor John R. Bangs, Jr., working from his office in Ithaca, has been chosen by the Society to direct this program of organization. Please give careful consideration to the statement from him which follows.

Very sincerely yours,

WALKER L. CISLER, *President*

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DEAR FELLOW ENGINEERS:

With the establishment of the Pittsburgh section of the Cornell Society of Engineers, we have made a beginning toward an active national organization. It is now proposed to form similar groups in Schenectady, Buffalo, Philadelphia, Cleveland, St. Louis, Detroit, Baltimore, and other areas where alumni of the Colleges of Engineering are concentrated. Each group will be represented on the Executive Committee of the society by a regional vice president.

JOHN R. BANGS, JR.
Courtesy Cornell Alumni News

In most areas, the activities of the section can be effectively coordinated with those of the local Cornell Club. In Pittsburgh, for example, one meeting of the club each year is to be devoted to engineering, with a program under the direction of the Pittsburgh section of the Society of Engineers. Such a plan will benefit both the society and the club.

Besides participating in such meetings, each member of the society will receive, as in the past, monthly issues of THE CORNELL ENGINEER, bringing the latest news from the campus, official news of the society, and interesting articles, both technical and non-technical, by alumni, students, and members of the faculty of the College. Sample copies of the December issue, giving a complete written and pictorial description of the program to strengthen the staff and facilities of the College, are available on request. Annual dues are still only $2.00

I shall be very glad to receive suggestions concerning the formation of local groups from alumni in any part of the United States. My committee stands ready to aid in every possible way.

Yours sincerely,
JOHN R. BANGS, JR.
Chairman, Committee on Regional Organization,
College of Engineering,
Ithaca, N. Y.

News of the Alumni

THOMAS HALL, ME '93, MME '94, a former member of the Cornell engineering faculty who for the last 31 years had been associated with the Elliott Company, died at his home in Harrisburg, Pa., September 29, 1938.

In his undergraduate days he was a member of the football team, playing tackle alongside "Pop" Warner, the famous coach who is now at Temple, and was also for three years the stroke of the varsity crew. For four years after graduation he stayed in Ithaca taking graduate work and serving on the faculty of Sibley College. His specialty was Corliss steam engines, and he at one time built in the Sibley shops a boiler and engine for 500 lb. pressure, an extraordinary accomplishment in those days.

In 1907 he went with the Ridgway Dynamo and Engine Company to design a new line of engines. For the last 15 years he was consulting engineer on steam engines for the Elliott Company.

●

DR. R. P. DAVIS, MCE '08, PH.D. '14, has been elected president of the West Virginia Society of Professional Engineers. He has been dean of the College of Engineering, University of West Virginia, since 1932.

Previous to that time he was connected with the American Bridge Company, was instructor in bridge engineering at Cornell, professor of structural and hydraulic engineering at West Virginia University and bridge engineer and consulting bridge engineer of the State Road Commission of West Virginia. He is a director of the American Society of Civil Engineers and a member of the committee on iron and steel structures of the American Railway Engineering Association. He is also a member of the committee on engineering instruction of the Association of Land-Grant Colleges and Universities, of the American Society for Testing Materials, of the Society for the Promotion of Engineering Education, of Sigma Xi, and Tau Beta Pi, honorary engineering and scientific societies.

●

JAMES W. PARKER, ME '08, vice-president and chief engineer of the Detroit Edison Company, took office December 6 as vice-president of the American Society of Mechanical Engineers for the coming year.

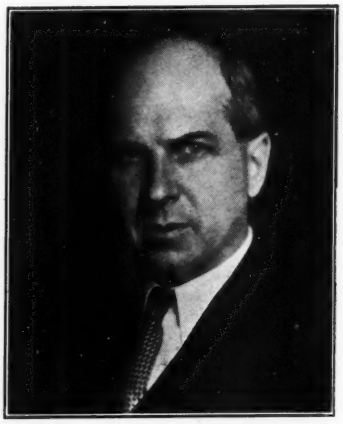
Mr. Parker is a member of the Board of Trustees of the University and is chairman of the Engineering Council, an organization of Trustees, adminstrative officials, and alumni especially interested in the progress of the College of Engineering. He has been with the Detroit Edison Company since 1910, rising from boiler-room engineer to his present position. Parker has lectured frequently at the College of Engineering.

Space is now available for ⅛ and ¼ page professional cards and announcements.

Those who recall the page devoted to personal and professional cards last printed several years ago, will recognize the advertisement of Whiteman, Requardt and Smith on page 2 as the first of a new "Professional Page" for the use of our alumni. For space rates and other particulars please write our advertising manager, T. L. Snowdon.

HURLBUT S. JACOBY, AB '08, CE '10, died on November 16 in Columbus, Ohio, where he was director of the Department of the Industrial Research and field director of the Engineering Experiment Station at Ohio State University. He had held these positions since 1934.

"Four years had brought much accomplishment," says the December issue of Ohio State's Experiment Station News. "Mr. Jacoby had made friendships in all departments of the University and among leaders of business in



Ohio and throughout the nation. He had negotiated many agreements for cooperative investigations.

"Mr. Jacoby's industry and enthusiasm in organizing the Ohio State University Research Foundation and directing its activities were typical of his entire career in civil engineering and business. He grew up at Cornell University where his father, Henry S. Jacoby, a famous structural engineer and author, was a professor."

After graduation from Cornell, he joined the McClintic-Marshall organization in Pittsburgh. Later he was chief engineer of the Standard Steel Construction Company of Welland, Ontario, a teacher at Pennsylvania State College, district engineer of the Austin Company, secretary and chief engineer of the H. K. Ferguson Company, and during the NRA days served in Washington with the division of machinery and allied products.

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WITH CORNELL DAY scheduled for the first week in May, the College of Engineering, in anticipation of holding another exhibition of alumni achievements, has renewed the invitation to all alumni to send photographs, descriptive material, reprints of articles, models, or anything else that indicates what part they are playing in American industry and business. The Commencement exhibit last June attracted attention from many visitors and led to the establishment of a permanent collection of material for similar exhibits in the future.

On Cornell Day, the College especially desires to have a representative display for the information of prospective students. Material should be sent as soon as possible to Dean S. C. Hollister, College of Engineering, Ithaca, N. Y.

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HOMER R. SEELY, CE '17, has been named deputy commissioner of public works for the City of New York. Seely was previously an engineer with the Port of New York Authority.

News of the Alumni

Following his graduation Seely worked for the Bethlehem Steel Corporation from 1919 to 1923. For the next two years he served on the Delaware Bridge Joint Commission in Philadelphia and from 1925 to 1934 he was with the Port Authority. He joined the Triborough Bridge Authority in 1934, continuing to 1937, when he returned to the Port Authority. He has worked on the Triborough Bridge, the George Washington Bridge, and the Lincoln Tunnel.

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PROFESSOR J. R. BANGS, JR., M.E. '21, has been reappointed chairman of the Committee on Professional Status and Employment of Engineering Graduates in the Society for the Promotion of Engineering Education. This committee consists of the following prominent men: L. M. K. Boelter, University of California; M. M. Boring, General Electric Company; C. E. Bullinger, Pennsylvania State College; P. H. Daggett, Rutgers University; H. L. Davis of New York; O. W. Eshbach, American Telephone & Telegraph Company; O. A. Leutwiler, University of Illinois; F. A. Magoun, Massachusetts Institute of Technology; J. E. McDaniel, Georgia School of Technology; and E. M. Stephens, United States Steel Company.

Professor Bangs is also a member of the Committee on Industrial Engineering of the Society.

•

CAPT. GORDON E. TEXTOR, CE '28, has been appointed assistant to Maj. B. M. Harloe, new WPA assistant administrator and chief engineer, according to dispatches from Washington. He spent a year in the School of Civil Engineering here after completing his training at West Point.

Mrs. Textor, the former Mary Gertrude Ryan of Ithaca, was a student in the College of Home Economics in 1923-27.

•

DR. H. H. RACE, ME '22, PH.D. '27, of the General Electric Research Laboratory in Schenectady who was from 1923 to 1929 a member of the faculty of the School of Electrical Engineering, has been appointed chairman of the Committee on Sections of the American Institute of Electrical Engineers for the year 1938-39. He is also a member of the Institute's committees on planning and co-ordination, research, and basic sciences.

His most recent research has to do with microphysical and microchemical methods of detecting the destructive effects of ions on electric cables.

FORTY-ONE SONS OF CORNELL ENGINEERS IN FRESHMAN CLASS

That Cornell engineers believe in sending their sons to Cornell is proved by the forty-one freshmen entering the College of Engineering who have alumni fathers with engineering degrees. These forty-one men are included in the group of 245 sons and daughters of alumni who entered the University this fall.

This group of second generation engineers is twenty-five per cent larger than the similar group which entered last year. The class of 1941 could boast of only thirty-three Cornell engineer fathers.

These are the alumni listed with their descendants:

'75 ME George S. Moler (Grandfather) ..... George F.
'10 CE Howard T. Critchlow (Grandfather) ....George F.
'93 CE Albert H. Perkins .....Corles M.
'97 ME Frederick D. Herbert.....Wilbur F.
'00 ME Frederick G. Grimshaw .....Frederick G.
'05 ME Howard Dingle .....John R.
'05 ME Gustavus A. Kositzky .....Robert G.
'06 ME John C. Wilson .....Thomas B.
'07 ME Walter C. Kennedy .....Thomas I.
'07 ME Alexander C. Stevens .....Alexander C.
'07 ME Walter W. Storm .....Walter E.
'08 ME Ralph C. Schwarz .....Ralph C.
'09 ME Peter T. Vanderwaart .....Peter D.
'10 ME Michael J. Konstan .....Paul
'10 ME Thomas E. Orbison .....Frank H.
'11 ME Joseph B. Campbell .....Joseph I.
'13 CE Charles O. Brown .....Charles O.
'13 CE Russell D. Welsh .....John P.
'13 ME Ambrose Ryder .....Edson
'14 ME Robert H. Shaner .....Robert H.
'14 ME Lynn B. Timmeron .....Lynn D.
'14 ME John Carlton .....John
'15 ME Karl H. Mayer .....Bruce M.
'15 CE Charles R. Adelson .....Richard H.
'15 ME Jacob R. Fry .....John J.
'15 CE David N. Milham .....David W.
'15 CE Oscar E. Zabel .....Robert P.
'16 ME James H. Moore .....James H.
'16 CE Norman W. Barrett .....Norman W.
'16 CE Arthur E. La Croix .....Robert E.
'16 ME Raymond A. Lander .....Raymond A.
'16 ME Robert G. Meyler .....Robert G.
'16 CE Rowalnd K. Bennett .....William A.
'17 ME Henry W. Jones .....Henry W. III
'17 ME Mortimer S. Parkhill .....Donald B.
'17 ME Alan Passmore .....Lincoln A.
'17 ME Everett C. Read .....Walter R.
'17 Charles A. Hoffman .....Charles A.
'18 ME Hamilton H. Roberts .....Hamilton H.
'18 CE Robert C. Edmunds .....Robert T.
'18 ME Lloyd H. Tilley .....William H.
'19 CE John E. Laird .....John J.

Use The **CORNELL UNIVERSITY PLACEMENT BUREAU**

WILLARD STRAIGHT HALL **H. H. WILLIAMS, '25, Director**

WITH THE

TRAPPING SOUND WAVES

"A subject which we all would be more interested in if it weren't so successful," the muffling of internal combustion engine exhausts, was the topic of a lecture given by Prof. G. B. Upton at the combined meeting of the Student Branch and the Ithaca Section of the A.S.M.E. at Willard Straight Hall on Friday, December 9, 1938.

Tracing the development of mufflers from World War research for quieting airplane motors to the seldom considered but very important item on the modern automobile, Prof. Upton outlined how "noise" is analyzed and methods by which it can be muffled.

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THRU THE EYES OF A JUNIOR ENGINEER

Relating his summer engineering experiences at the Pratt and Whitney Aircraft Corporation, Dick Smith, '39 M.E., told how modern airplane engines are built, tried, and tested. At a meeting of the A.S.M.E. in Room 2, West Sibley, on November 28, his talk held great interest for student engineers as he explained the tasks and responsibilities of a junior engineer in such a closely coordinated and highly technical occupation as the construction of airplane motors.

●

CORNELL HAS ITS OWN RAILROAD

Becoming the third of its kind in the country, a university model railroad, The Cornell & Cayuga Railroad has recently completed some 700 sq. ft. of table-work in preparation to laying an estimated 1200 feet of track. All equipment on the "C & C" is built to a scale of 17/64" to the foot. Motive power consists of four scale locomotives with rolling stock totaling fifteen cars of various types.

The layout is housed in the basement of the home of Dean S. C. Hollister of the College of Engineering. The rough design is a route extending from Ithaca to Auburn along the east side of Lake Cayuga. The condensing of 40 odd miles of terrain into a room 15' x 50' takes a bit of ingenuity and a good deal of imagination, but the main items are present, including a station at "Aurora."

Having members from several colleges of the University, with engineering students predominating, the Cornell & Cayuga operates every Friday evening from eight to eleven P. M. Then the model railroaders meet to solve problems in track design, construction, signalling, and most important of all, operation of trains that are kin to the real thing in everything but size.

Students interested are invited to drop in at the layout at 5 Grove Place any Friday evening, or to get in touch with the Railroad's General Manager, Colin C. Eldridge, '41, ME at 625 University Ave.

●

ATMOS

Atmos initiated the following men on December 1st: Paul Bracht, Clay Davis, William Dixon, Udo Fischer, J. Michael McLellan, Jansen Noyes, Francis Thomas, Dean Wallace, Jim Wilder, and Edward Zouck.

●

CHI EPSILON

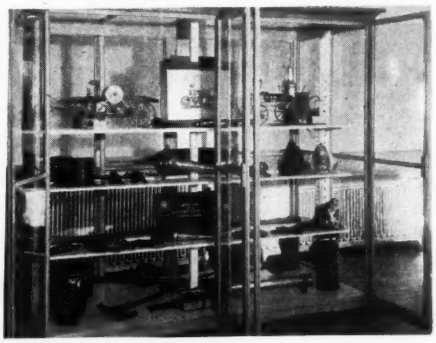
Herbert Williams spoke on the subject of job getting technique at the initiation banquet of Chi Epsilon. The following men were initiated; Farrand Benedict, Melvin Blessing, Jr., William Fisher, William Gay, Charles Hunt, and Paul Swatek.

ETA KAPPA NU

An initiation banquet was held in Willard Straight on January 6 for the following new members of Eta Kappa Nu; Crawford Adams, Edward Clayton, Reuben Close, Arthur Harrington, Arthur Jette, Joseph Marshall, and Robert Petrie; all of the class of 1940.

NEW EXHIBIT IN SIBLEY DOME

Because of the leading position attained by Elmira, Utica, Seneca Falls, Hudson, Waterville, and other upper New York State cities in the development and production of fire-fighting apparatus, Cornell University has been chosen as the recipient of a $2,000 collection of early American fire-fighting relics. The exhibit, numbering 50 pieces and including model hand-drawn apparatus, prints of fire scenes, and actual leather water buckets, firemen's hats, horns, rattles, axes, torches, and other articles used before 1870, has been permanently loaned to the University by the Insurance Company of North America and is on display in the engineering library, Sibley Dome.



The models include a hand-drawn hand pumper, 1776; a hand-drawn hook and ladder truck, 1815; a hand-drawn hose reel, 1835; and a hand-drawn steam fire engine, 1856. A section of copper riveted leather hose, two hand sewn leather fire buckets, and three leather helmets are also included in the exhibit, together with two volunteer firemen's parade hats worn in Colonial Days, a work horn and rattle used to call the company together, a trumpet of ornate design for use in parades, and various other articles of interest.

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A. I. CHEM. E. ACTIVITIES

The American Institute of Chemical Engineers has been showing great activity this year. They started the season off in November with an inspection trip to the Great Western Wineries in Hammondsport, N. Y. The trip was made primarily to study fermentation processes. The hit of the whole trip however seems to have been the champaign donated by the Great Western Company.

T. H. Chilton, director of the Dupont experimental station will speak at the next meeting of the society on January 18 in the main lecture room in Baker. He will discuss recent developments in the field of Chemical Engineering, and will show slides and movies illustrating experiments on boiling liquids.

"Refining the Crude" was the title of a motion picture presented at the first formal meeting of the Ithaca chapter of the American Institute of Chemical Engineers on Thursday evening, December 15. The picture, which was pre-

AT THE END OF

sented jointly by the United States Bureau of Mines and the Gulf Refining Company, explained very simply and clearly how crude oil is taken from the ground, how fractional distillation and "cracking" are used to give high grade gasoline at low cost, and how the other products are used.

After the picture, a short business meeting was held at which sub-officers were elected and plans announced for the Cornell Day show. The sub-officers are fourth year men and will serve as assistants to the regular officers until next year, when they will become the regular officers of the A. I. Chem. E. The sub-officers are: Joseph Coors, '40, president; John C. Tallman, '40, secretary; and Donald R. Whitlock, '40, treasurer.

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A.I.E.E.

H. C. Koenig, engineer in charge of the electrical department of the Electrical Testing Laboratories, New York City, gave an illustrated lecture on "Uncommon Tests of Common Devices" before the Ithaca Section of the American Institute of Electrical Engineers Friday, December 16, at 8 p. m. in the main lecture room of Franklin Hall.

The discussion included a variety of special tests on household flatirons, electric washing machines, typewriter ribbons, safety glass, and automobile lighting acessories. Actual demonstrations of several of the tests were made in the lecture. A great deal of interest was shown in the demonstration of the manner in which the new safety glasses for use in automobile windshields broke upon impact. Mr. Koenig dropped steel balls and other weights on sheets of the glass and pointed out that the glass was very hard to break and when it broke the pieces held together and did not scatter. One piece of heat treated glass broke in a most unusual pattern and broken pieces were carried away by the audience as souvenirs.

Mr. Koenig, who has had many years of experience in the testing of all sorts of electrical equipment, spent almost an hour following the talk in answering questions asked him by the audience.

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MC MULLEN SCHOLARSHIPS ANNOUNCED

The College of Engineering of Cornell University has announced the 1939 competition for John McMullen Regional Scholarships in Engineering, which carry $400 a year throughout the College course. Full information has been sent to secondary school principals throughout the country.

These scholarships, open to qualified secondary school seniors, are awarded on the basis of scholastic achievement, character, and general ability. Applications must be filed before April 1, 1939, on the official blanks.

Thirty scholarships are distributed by regions covering the entire United States, except New York State, as follows, the numbers in brackets indicating the number of scholarships assigned to each region:

No. 1, New England (2); No. 2, Pennsylvania (3); No. 3, New Jersey (3); No. 4, Delaware, Maryland, District of Columbia, Virginia (3); No. 5, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana (1); No. 6, West Virginia, Kentucky, Tennessee (1); No. 7, Ohio (2); No. 8, Indiana, Michigan (3); No. 9, Illinois (3); No. 10, Texas, Oklahoma, Arkansas (2); No. 11, Missouri, Nebraska, Kansas (2); No. 12, Iowa, Wisconsin, Minnesota (2); No. 13, Northa Dakota, South Dakota, Montana, Wyoming (1); No. 14, Colorado, Arizona, New Mexico, Nevada, Utah (1); No. 15, California, Oregon, Washington, Idaho (1).

Fields of study open to students in the College of Engineering at Cornell University include Mechanical Engineering, Civil Engineering, Electrical Engineering, Chemical Engineering, and Administrative Engineering in Mechanical, Civil, or Electrical Engineering.

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ARCHITECTS MEET

What's this—cooperation from the White Hall pencil pushers? Well, maybe its the exception that proves the rule, for at the meeting on December 12, Aymar Embury, II, architect spoke on "The Esthetics of Engineering Structures," under the joint auspices of the College of Architecture and the College of Engineering. He pointed out that there is a significant change occurring in the relation between architects and engineers working on engineering structures. Formerly, he said, engineers would design the bridge and then call in an architect to decorate it. Today the architect works with the engineer from the start and sometimes, by his passion for simplicity in structure, suggests ways in which the engineer can construct more effectively and economically.

The talk was illustrated by architectural drawings and photographs of numerous bridges. They served to emphasize his point that the architect can select a design that emphasizes rather than covers up, the ways in which the physical forces actually work to make the structure serve its purpose.

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GRADUATE SCHOLARSHIPS OFFERED

A number of graduate scholarships and fellowships in engineering are offered for 1939-40 by Cornell University to graduates of accredited schools and colleges of engineering. The College of Engineering will award this spring 12 John McMullen Graduate Scholarships of an annual value of $1,000 for students interested in pursuing research and working for an advanced degree, as well as the Elon Huntington Hooker Fellowship in Hydraulics, with a stipend of $150 a year for research in experimental hydraulics in Europe or America.

The following additional scholarships and fellowships in engineering are offered by the Cornell Graduate School: in civil engineering, the McGraw Fellowship, $400 a year and free tuition, and a University Graduate Scholarship, $200 a year and free tuition; in mechanical engineering, the Sibley Fellowship, $400 a year and free tuition, and the Edgar J. Meyer Memorial Fellowship, $400 a year and free tuition; and in electrical engineering, the Charles Bull Earle Memorial Fellowship of $400 a year and free tuition.

Applications should be sent either to the dean of the College of Engineering or the dean of the Graduate School, as indicated above, before March 1. Further information may be obtained from Dean S. C. Hollister of the College of Engineering.

Do You Know These Men ?

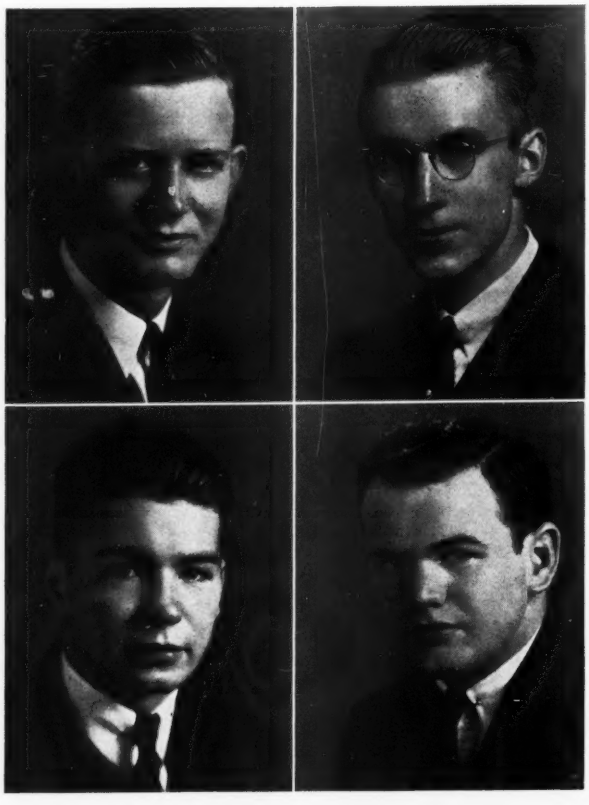
FREDERICK FAY REIMERS '39 A.E., M.E.

"Sach", as Fred is known at the Sigma Phi house, is an outdoor man. He has spent nine summers as camper and councilor in the Canadian Wilds and the last two summers in an Idaho lumber camp. His vacations are spent hunting, fishing, camping, and collecting Indian relics.

Sach was pleased enough with Ithaca's snow his freshman year to buy a pair of skiis. When, all in one afternoon, he sprained his ankle on the library slope and his roommate broke one of his skiis on the golf course. Sach gave up skiing. Could it be music that makes Sach so popular whenever he goes out?

"Education and friends are the two greatest benefits I have gotten from Cornell," remarked Sach as he sat on his desk with his feet under him, "and I feel that every one should go out for some activity." Sach has lived

(*Continued on page* 23)



ROBERT M. GIFFORD '39 A.E., E.E.

Many are the Cornellians whose tiresome treks to eight o'clocks, noonday festivities, weary ploddings home at evening, and dreary Sundays have been cheered and softened no little by the omnipresent Clock Tower chimes, but few realize that it is often Bob Gifford who is responsible for this boost. It takes a great deal of time in planning and practicing for these thrice-daily recitals, but as in everything else he does, Bob enjoys himself to the utmost. His love and talent for music have not only earned him the position of senior chimesmaster, but also the position of accompanist for both the Glee Club and the Instrumental Club.

Bob has gained practical experience during his Freshman and Sophomore vacations doing tracing detail work with the Chicago Pneumatic Tool Company, where he decided that he did not under any circumstances have the desire to become a draftsman. His

(*Continued on page* 23)

THOMAS ISAAC SLACK BOAK, JR. '39 M.E.

"Within the next few years, 150 lb. football will be second only to varsity football," Tom, manager of 150 lb. football, expressed himself. Tom is a firm believer in extra-curricular activities. Contacts and the chance to develop leadership are the two valuable opportunities that he gained at Cornell. The football rallies have been a fine example of his leadership. His work as President of Spinhx Head, Secretary-Treasurer of Atmos and President, Housemanager and Treasurer of Beta Theta Pi have given him valuable experience that he will use after college.

During his vacation, Tom may be found at sea off New Haven with his father and brother sailing in their 30 foot sloop. The rest of his spare time is devoted to his camera or to his guns.

His summers have been spent with the Winchester Repeating Arms Co. at

(*Continued on page* 23)

PAUL A. SCHAAF '39 C.E.

Athletics and mathematics may not ordinarily go together, but Paul Schaaf's versatile nature combines the two as his chief interests. Besides skating and swimming for his own pleasure, Paul plays Varsity 150 pound football. Before coming to Ithaca, he won the novice wrestling championship of Buffalo in the 135 pound class.

In contrast to these out-of-door interests is his hobby of mathematical puzzles. If you have a tricky problem with numbers in it, just ask Paul and he will delight in attempting to solve it. He has several books in his room describing ways of getting fun out of mathematics. Naturally he enjoyed his math courses most in his four years of Civil Engineering.

When asked what he considered the most valuable part of his education, Paul replied, "In addition to the technical knowledge I have gained, I value very

(*Continued on page* 23)

PERSONALITIES

(*Continued from page* 22)

FREDERICK FAY REIMERS '39 A.E., M.E.

up to this as his record shows. After graduation Sach plans to work in the family lumber business, assisting the operation of a furniture mill.

Home address: Hammond, La.; Activities: Wrestling 1, 2, 3, 4, Captain 1, 3, 4; Interfraternity Rowing; Football; Volleyball; Track; Chairman Vigilance Committee; Sophomore Smoker Committee, Junior Prom Committee; President of Kappa Tau Chi; member of Red Key, Quill and Dagger; song leader Sigma Phi.

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ROBERT MacGREGOR GIFFORD '39 AE., E.E.

Junior vacation was spent with the Ohio Power Company in installing a new transformer in a sub-station on a construction job. He proudly relates how he acquired six blisters the first day in digging ditches for the new foundation. Because of his particular dislike for technical work, Bob is planning to do sales work with respect to motors, generators, and large electrical equipment after graduation.

He values just as highly as his curricular work and his general engineering background, the experience gained through social contacts. "It would be difficult indeed," he remarked, "to find a better group of fellows than in engineering at Cornell." And this attitude is reflected in Bob's friendships on the campus.

Home address: Cleveland Heights, Ohio; Activities: Cross country, track, interfraternity football, basketball, tennis, chimesmaster, Glee Club and Instrumental Club (Accompanist); Circulation Mgr. CORNELL ENGINEER 1937; Tau Beta Pi; Kappa Tau Chi; Red Key; Savage Club; Quill and Dagger; House Mgr., Secretary, Lambda Chi Alpha; Sophomore-Frosh Flag Rush Com.; Frosh Advisory Com.; Frosh Camp Counselor.

•

THOMAS ISAAC SLACK BOAK, JR. '39 M.E.

New Haven. After working with the men in the shop, Tom feels that he is no longer considered as just another college boy but as one of them. Upon graduation Tom hopes to continue in this work of industrial management in which he has had such a good start.

Home address: New Haven, Conn.; Activities: Freshman Wrestling, Football Competition, Manager of 150 lb. Football, Chairman Junior Smoker Committee, Junior and Senior Member Frosh Advisory Committee; President of Sphinx Head, Secretary-Treasurer of Atmos, Red Key President, Housemanager and Treasure of Beta Theta Pi.

•

PAUL ARTHUR SCHAAF '39 C.E.

highly the social contacts I have made. Working as an officer in honor societies, I have made many contacts, and have learned to shoulder new responsibilities." Among the responsibilities he has supported in cooperation with other members of the honor societies has been the revival of the honor code in the Civil Engineering school. "The thing is working well in the C.E. School," said Paul, "and I would like to see it extended to the other schools."

After graduation he plans to enter the construction field in his father's firm. Later he intends to organize his own firm. In preparation he has spent his summers working on construction jobs and in drafting rooms.

Throughout his education Paul has attempted to keep a balance between his mental and social inclinations, and between work and pleasure, even finding time to read Wodehouse and Damon Runyan. His record bespeaks of the success he has had in getting the most out of his education.

Home address: Buffalo, New York; Activities: Varsity 150 lb. Football; President of Rod and Bob; Secretary of Chi Epsilon; Cataloger of Tau Beta Pi; Intramurals; Member of Alpha Chi Rho fraternity.

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BOOK LIST

(*Continued from page* 9)

Macmillan. If the reader of the Odyssey finds his pulse rate rising as he reads, he might try the "Iliad" also and some of the Greek tragedies, especially those of Euripides as translated into rhyming couplets by Professor Gilbert Murray.

Then the reader might venture on a few books out of the twelve of Virgil's "Aeneid". There is a good complete translation of Virgil by John Jackson, Oxford Press.

A little book: "Asgard and the Norse Heroes", by Miss K. F. Boult, in Everyman's Library (Dutton) tells the stories of the Norse Mythology. Also one may read the great Epic of the North in: "The Fall of the Nibelungs", translated by Margaret Armour, (Everymans Library). Then one may continue by reading: "The Saga of Grettir The Strong", (Everyman's Library), and the Icelandic "Laxdaela Saga". (J. M. Dent).

William Norris, in his "Earthly Paradise" has retold many of the world's enduring stories; thus he has put the Laxdaela Saga into his own poetic form under the title: "The Lovers of Gudrun".

Every reader should have a copy of Palgrave's "Golden Treasury of Songs and Lyrics". There are many editions, and several are of such size as will slip easily into one's coat pocket, ready to come forth to fill intervals in the day's work or play. This book is filled with suggestions leading toward all that is best in the poetry of the period it covers.

The writer has told briefly of a few out of his many enthusiasms for books of imaginative literature. It is his hope that these hints may start some engineers toward the formation of the reading habit. It is the start that is important; for when the reader finds how much this habit means in increased power in all of life's activities, increased enjoyment in living, and increased helpfulness to others, he will never stop.

FACULTY PERSONALITIES

GUY EVERETT GRANTHAM, AB, AM, PhD

Phi Beta Kappa, Sigma Xi, Gamma Alpha,
Professor of Physics

Professor Grantham is a well known figure to every engineer on the campus as a lecturer in Freshman Physics. To some of us he is known as an authority on physics in general and light in particular. Like most professors, however, he is little known as a man.

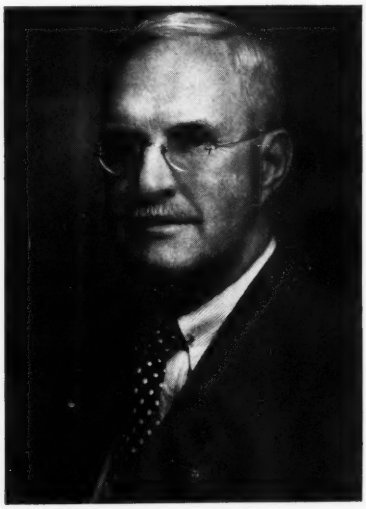
Professor Grantham first came to Cornell as an Assistant in 1916-17, leaving to serve as a captain in the American Expeditionary Forces of the U. S. Army till 1919. He then went to Texas A. & M. and thence to the Naval Academy, serving as Associate Professor of Physics at each, and returning to Cornell as an Assistant Professor in 1928. Previous to his first engagement at Cornell he was an instructor at Purdue. He is a graduate of Indiana University, receiving his A.B. there in 1909 and an A.M. in 1913. Cornell awarded him his Ph.D. in 1920.

A married man with one daughter, Professor Grantham lives "out on the heights". One of his favorite hobbies is cultivating the numerous flower gardens which surround his home. Other hobbies include reading French and German, and traveling. Professor Grantham traveled through England and France in 1917, and made an extended European tour in 1936.

Numerous societies occupy much of his spare time. Professor Grantham is a Mason and holds membership in the American Physical Society, American Optical Society, American Association for the Advancement of Science, and Society for the Promotion of Engineering Education.

Professor Grantham is well known in his field as an authority on light, and is co-author of Franklin and Grantham's "General Physics." He has in addition written three papers for the "Physical Review," two of them on infra-red light.

In conjunction with the work on infra-red light, Professor Grantham has also done research on the sensitivity of selenium cells.



WILLIAM LINDSAY MALCOLM, MA, BSc, MCE, PhD, MEIC

Director, School of Civil Engineering

Dr. Malcolm comes to Cornell from Queens University, Kingston, Ontario, leaving behind him a brilliant record as a teacher and as an engineer. He is a graduate of Queens, having received his M.A. there in 1905 and a B.Sc. in Civil Engineering in 1907. He has been closely connected with Cornell, however, having received here the degrees of M.C.E. in 1934 and of Ph.D. in 1937.

With the exception of five years overseas during the World War, Dr. Malcolm has been a member of the faculty at Queens since receiving his B.Sc. degree in 1907. During 1914-19 he served with the Canadian Engineers, attaining the rank of Lieutenant Colonel. He is at present a member of the advisory board of the Royal Military College.

Dr. Malcolm designed and built the stadium and ice hockey rink and the sanitary engineering laboratory at Queens. This laboratory is now considered one of the finest of its kind on the continent.

He is a member of the Engineering Institute of Canada, the American Water Works Association, the Canadian Institute of Sewage and Sanitation, the New York State Sewage Works Association, the Professional Engineers of Canada, and the American Society of Civil Engineers.

Dr. Malcolm, although not a young man, is extremely active. At a recent dinner in his honor given by the Kingston branch of the E.I.C., Lt. Col. Grant, M.E.I.C., made the following statement: "At a time of life when most men would be content to rest on their laurels, Dr. Malcolm has forged steadily ahead." The truth of this statement is rapidly becoming evident at Cornell. Dr. Malcolm carries the weight of a responsible position, but does so with a genial attitude rarely found among men in this position. He finds time for numerous activities, and has long been an ardent baseball fan.

He has been at Cornell since July, succeeding Professor Paul H. Underwood, who had been acting director of the School of Civil Engineering since Professor Hollister became dean of the College of Engineering.

They can't talk those telephones to death

. . . *because Bell telephones can "take it"*

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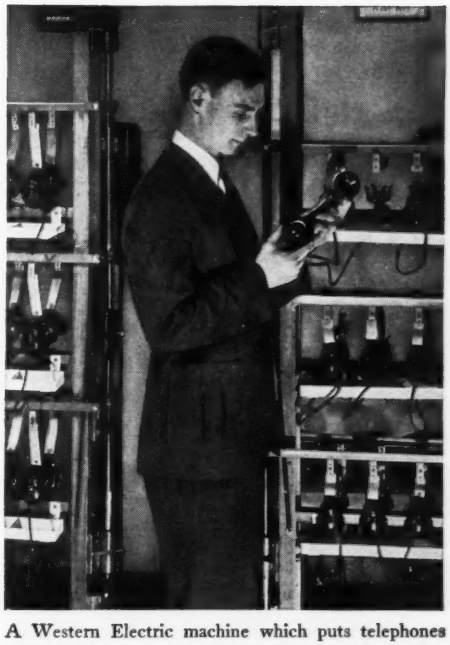

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GRIT REMOVAL

(*Continued from page* 8)

by mixing and that the density of sediment in the mixture is the same as it is in the effluent. The mathematical development of this expression is given by Hazen in his original paper. The assumptions for this formula are difficult to visualize and difficult to reconcile with the rational development of sedimentation relations for an ideal basin. Mixing such as is assumed would require violent agitation to maintain grit in such a state of suspension. It is probable that these conditions are more applicable to the subsidence of smaller and lighter particles. This relation was used as a lower limit of basin performance.

TABLE II

Detention period in terms of time required for one particle to settle from top to bottom

a/t=bv/e (300 M.G.D. 60°F.)

Tank Area	Particle Size								
Sq. Ft.	1.0 mm.	0.80	0.60	0.50	0.40	0.30	0.20	0.15	0.10
2500	2.06	1.71	1.30	1.09	0.87	0.66	0.43	0.31	0.16
5000	4.12	3.42	2.60	2.18	1.74	1.32	0.86	0.62	0.32
7500	6.18	5.13	3.90	3.27	2.61	1.98	1.29	0.93	0.48
10000	8.24	6.84	5.20	4.36	3.48	2.64	1.72	1.24	0.64

For an "ideal" basin, as previously pointed out, figures greater than 1.0 indicate 100 per cent removal and figures less than 1.0 are the removal proportion for that size, assuming the entering quantity to be unity. A practical value of 1.5 for a/t has been proposed as a minimum for satisfactory basin performance. This

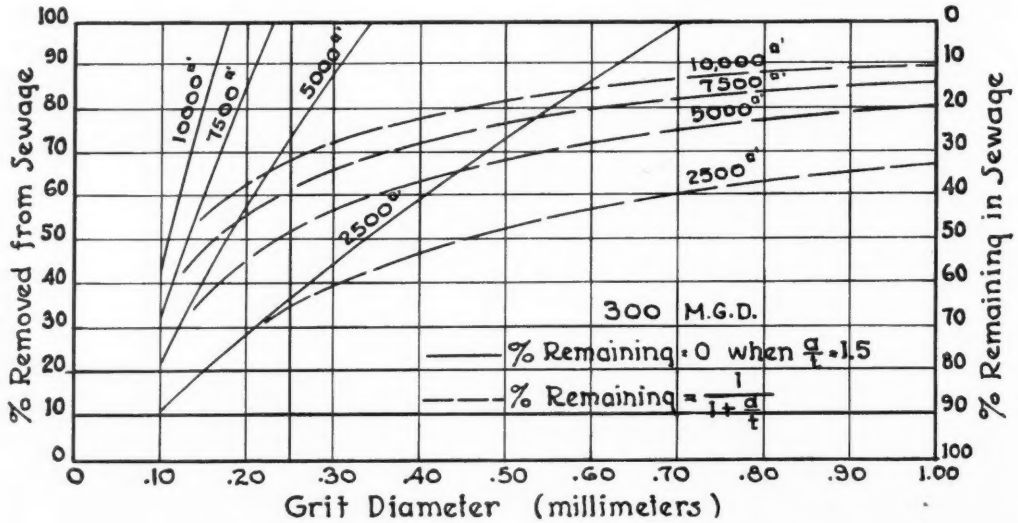

FIGURE 2. COMPARATIVE TANK PERFORMANCE

A great deal of controversy exists over the validity of theoretical sedimentation expressions, but most of the argument is centered around the application of such expressions to tanks which handle lighter organic solids. In such tanks, the effect of flocculation, vertical mixing and the presence of a sludge blanket, tend to destroy the basic assumptions. For grit chambers, it can reasonably be assumed that such factors are not effective to any great degree. For this reason, sedimentation theory may be more properly applied to the settling of grit particles than to the settling of organic solids in primary and final sedimentation tanks.

It was assumed for the Baltimore tanks that the probable installed basin area would be less than 10,000 square feet. Table II was prepared to show a/t values for various grit sizes in basins of 2,500-, 5,000-, 7,500- and 10,000-square foot area with flows of 300 M.G.D. The figures were obtained by dividing the basin area (in sq. ft.) by the quantity treated (in cu. ft. per sec.) and multiplying the result by the subsiding velocities (in ft. per sec.) given in Table I.

relation was used by assuming 100 per cent removal for values of a/t=1.5 and for values of a/t less than 1.5 removals were considered to be the direct ratio of a/t values to 1.5. Comparative basin efficiencies computed by this method as well as the "one basin continuous" method are shown by curves on Figure 2.

Mechanical analyses of sewage grit indicate that in general approximately 70 per cent of sewage grit will be retained on a No. 60 screen (U. S. Std. 0.25 mm. opening). For the Baltimore tanks, it was thought that if reasonably high percentages of this size could be removed with correspondingly greater removals for larger sizes, basin performance would be satisfactory. Figure 2 shows that all particles 0.25 mm. and larger will be removed on the a/t=1.5 relationship when the basin area is 7,500 sq. ft. On the basis of "one basin continuous" relation, 60 per cent of this size will be removed. It is probable that actual removals will fall somewhere between these values. It is also apparent that on the "one basin continuous" curves a 10,000 sq. ft. area only gives approximately 5 per cent

(*Continued on page* 28)

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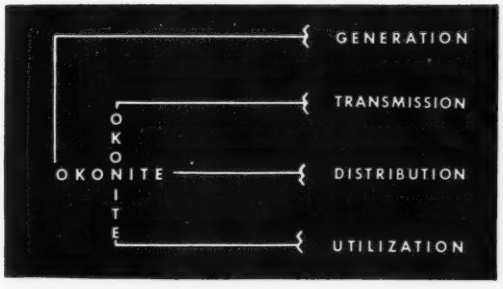

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(*Continued from page* 26)

greater removal than 7,500 sq. ft.

After considering these figures, it was decided to adopt a tank area of 7,500 sq. ft. Tank depths were then selected so as to provide reasonable detention periods and horizontal velocities not in excess of 1 ft. per sec. Various combinations of tanks of approximately 7,500 sq. ft. total area and suitable for the installation of standard grit removal equipment were then studied. Comparative cost estimates were found to be reasonably close. Square tanks as shown on Figure 1 were selected.

Three 50 ft. by 50 ft. tanks are now being constructed, each of which will be capable of treating 100 M.G.D. at maximum capacity. Normal practice was followed by locating these chambers on the downstream side of the coarse racks and the mechanical screens, and ahead of the primary sedimentation tanks. The theoretical detention period at maximum flow will be 100 seconds, the horizontal velocity 0.50 ft. per sec. and the depth approximately 6 ft. Influent and effluent gates are so arranged that any combination of tanks may be used. Sewage is admitted to the near side of the tanks shown on Figure 1 and discharged over submerged weirs on the opposite side. Each tank is equipped with 20 adjustable deflector plates, not visible, equally spaced along the influent wall to distribute the flow. Grit is moved toward the edge of the tank by scrapers attached to four arms on the rotating collectors, and deposited in an inclined cleaning and removal channel through the opening in the side wall. The capacity of the collecting mechanisms is well in excess of an estimated maximum grit load of 20 cu. ft. per M.G. Reciprocating rakes haul the grit up this channel and at the same time produce a washing action. Artificial flow induced by a small pump carries organic matter from the channel back into the main tank. A belt conveyor having a capacity of 24 tons per hour transports the grit through a covered trough 24 in. deep to the control building. By means of a bucket elevator of equal capacity, the material is deposited into trucks or into a storage bin.

This paper has described the preliminary stages of a grit chamber design based on sedimentation theory. It was realized that the removal proportions of grit computed by this method would be modified in practice by various basin disturbances, which were not considered in the calculations. Nevertheless it is believed that this approach to the problem gives a reasonable basis for the comparison of basin performance and a means of determining the size of units. When research and experimental studies in advance of construction are not feasible, a theoretical method is of definite value as a means of estimating removal proportions.

These grit chambers were designed by Whitman, Requardt and Smith, Consulting Engineers, Baltimore, Md. and Albany, N. Y., for the Bureau of Sewers, Baltimore, Md. The writer was in direct charge of preliminary studies and design. Acknowledgement is made to Bernard L. Crozier, Chief Engineer, George E. Finck, Sewerage Engineer, and C. E. Keefer, Associate Engineer, in charge of sewage disposal, for helpful suggestions and comments on the design. The construction is under the direct supervision of the Bureau of Sewers.

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G-E Campus News

RAINBOW-COLORED COURTS

SAN FRANCISCO built the island—now, General Electric is lighting it in all the colors of the rainbow.

The lighting of the Golden Gate International Exposition, which will open in February on man-made Treasure Island in San Francisco Bay, will be the most colorful ever undertaken. For it will illuminate in all the rainbow's colors the many buildings and beautiful "courts" on the island—the Court of the Moon, the Court of the Seven Seas, and others. More than 9000 floodlights are being used. The illumination is under the direction of A. F. Dickerson, Texas A. and M. 1910, Manager of the General Electric Illuminating Laboratory, at Schenectady.

The "rainbow of light" for the San Francisco Fair will be another in a series of General Electric lighting projects that have illuminated Chicago's Century of Progress, Brazil's Centennial Exposition, the Texas Centennial, and others. And as G-E engineers develop the project for San Francisco, again they are being aided by recent engineering college graduates and ex-Test men—the men who will design the brilliant exposition lighting of the future.

OPPORTUNITY FOR RESEARCH

SELECTED graduates of American colleges carry on research work each year in chemistry, physics, and physical chemistry with the aid of Charles A. Coffin Foundation Fellowships. These fellowships were established by General Electric in 1922 in honor of the Company's first President, Charles A. Coffin.

The awards are made by a committee of distinguished men. This year the committee consists of Dr. Bergen Davis, representing the National Academy of Sciences; Dr. Karl T. Compton, of the Society for the Promotion of Engineering Education; and Dr. John C. Parker, of the American Institute of Electrical Engineers. The candidates' applications, together with the faculty recommendations forwarded to General Electric by the various colleges, are the basis for the awards.

This year, applications for the fellowships must be in the hands of the Secretary of the Charles A. Coffin Foundation Committee, at Schenectady, on January 15, 1939.

HAWAII IN NEW YORK

TWO men sat down at a table recently and decided to air-condition Hawaii.

But they weren't concerned with changing the atmosphere above Diamond Head Mountain or the "Beach at Waikiki." Their problem was centered in Manhattan; "Hawaii" is the Hawaiian Room of New York's Hotel Lexington, where a 120-ton G-E air-conditioning system is being installed. Not only will it assure greater comfort for the patrons, but it will preserve an Hawaiian atmosphere—heretofore the atmosphere varied with New York's seasons.

The many Test men and ex-Test men assigned to air-conditioning work are ever seeking new applications for this G-E equipment. The results of their efforts can be seen in all parts of the country. Cliff House in San Francisco, overlooking the famous Seal Rocks, recently made its air-conditioned debut. "The Cradle," haven of homeless infants in Evanston, Illinois, is being similarly equipped, the equipment aiding in protecting the babies against infection by air-borne germs.

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